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## SCIENCE IN THE CENTRAL STATION.

One of the early methods of installing a new plant or erecting a new system was to go to a company which made a business of doing such work, consult it as to the needs of the new plant and the best plant to be adopted, and to turn the matter over to this company. This condition produced the consulting engineer, who takes the position that a man who is not affiliated with a supply house will be less biased in his selection of apparatus than one who is interested in the sale of a particular machine or system, and since he is free to choose what he wants he will produce a plant which will be more satisfactory to his client. The position of consulting engineer is now recognized and his work has resulted in a general effort to standardize apparatus and machinery in order to place everybody on the same basis. The companies doing the best work and turning out the best apparatus have appreciated the benefit to them of such a condition and they now wish to carry the practice further. This is indicated by several communications recently made to industrial organizations, urging purchasers to subject all material to a rigid inspection and to tests which will bring out its merits and its defects. A general adoption of this plan would weed out poor apparatus and even aid in improving the best. It would advance the art and benefit both producer and consumer.

At first the smaller central plants may be expected to object to anything which would seem to involve an increased expense, for if poor apparatus is to be tested they must have some one who is capable of testing. In other words, they must have a man who has had a technical training or who has been through the shops. But will not this result in an improvement at the station? It is not unreasonable to expect the man who has some technical knowledge and who knows something about the theory of the machinery under his charge will be able to produce better results, provided, of course, he has the necessary business qualities, than one who has the latter qualifications only and knows nothing of his apparatus. We believe there is a wide opening for the young men having a technical knowledge and who will fit themselves to handle business matters. The more scientifically we manage our business, the more successful should that business be. The more science we apply in the central station, the more satisfactorily should the station operate.

## TELEGRAPHY IN 1903.

Figures which have been collected by the London *Pall Mall Gazette* show that, during last year, the number of telegrams despatched in all countries reached the enormous total of 364,848,474. The country making the greatest use of the telegraph is Great Britain, which heads the list with 92,471,000 despatches. The United States comes second, with 91,391,000, and is followed by France, with 48,114,151.

*Telegraph and Telephone.*

It is interesting to compare these figures with recent telephone statistics published by the census bureau of the United States. The contrast is the more surprising, as the telephone figures are for 1902, a year earlier, and, as is well known, the telephone has been developing at an enormous rate of late. This report states that there were something more than 5,000,000,000 telephone messages exchanged in the United States. Thus, although the telegraph is twice as old as the telephone, the latter is used in this country over fifty times as much. Perhaps it is not quite fair to make this comparison, since the fields occupied by the two systems of communication are not entirely similar, nevertheless, while the use of the telephone has been growing rapidly, the telegraph is being used less frequently from year to year. The British post office reports that, for the year ending March 31, 1904, 89,997,000 telegrams were passed over its wires, showing a falling off from the previous year of 2.7 per cent. Part of the decline in the use of the telegraph is undoubtedly due to the telephone, but other causes seem to be at work. It

was asserted recently in one of our contemporaries that the great industrial combinations which have been formed have cut down enormously the number of telegraphic messages sent. Large business houses have always been good customers of the telegraph companies, and when a number of these companies pass under one control, the messages are reduced accordingly.

In comparing the use of the telegraph with the telephone, it should be borne in mind that while Great Britain leads in telegraphic messages, this country is far ahead in the frequency with which the telephone is used. Nor should it be forgotten that in one telephone conversation two persons take part, while the telegram represents a message in one direction only, and if it provokes an answer by telegraph, two counts are made.

## BREAKDOWNS OF ELECTRICAL MACHINERY.

Statistics showing the performance of any class of machinery are always interesting. Their value, however, depends upon the care with which the data have been collected, and upon due regard being paid to the class of machinery, to the district where it was manufactured, and to the service demanded of it. Thus, figures showing the breakdowns of electrical machinery, if compiled from a large district, should, if carefully collected, show the general performance of machines supplied to that district. To be reliable, these data must be collected from a large number of individual machines and plants. If the compiler limits himself to applications in a single line of work, his figures will indicate the suitability of the machines for that work, rather than the goodness of the general design. Statistics, therefore, must always be accepted with caution, and no reliance put upon them unless it is known how they were taken and for what object. When this information is supplied, usually some valuable points may be gathered from the figures.

### *Breakdowns in Different Applications.*

Bearing these points in mind, some recent data showing the performance of electrical machinery are of considerable interest. The statistics are given in the report of the chief engineer of the Engine, Boiler and Employers' Liability Insurance Company, of England, and they cover the accidents to the machinery insured by his company. The report shows that the rate of breakdowns of motors driving coal-cutting machinery is the greatest of all, the annual rate among this class of machines being about fifty per cent. In fact, motors working underground seem to be more liable to damage than any other class, a condition which is not at all surprising. Next to this class in the frequency of accidents come motors operating out of doors, driving shears, saws and portable tools in iron works, foundries, shipyards, etc. These machines are said to be subject to frequent breakdown. Next in the order of liability to accident come crane motors, and so on until, at the other end of the list, one finds dynamos and motors running in well-lighted, well-kept rooms, where they are under the care of a competent man. While perhaps there is nothing new in this finding, it seems to indicate that the motors intended for installation in mines and for outdoor work should be made even more robust and should be better protected than is the custom at present.

### *Liability of Different Parts to Accidents.*

As to the liability to trouble of the different parts of machines, more than half of the breakdowns occurred to the moving parts. For dynamos this was sixty-two per cent; for motors, a little over fifty per cent. The breakdowns to the stationary parts are about the same in both dynamos and motors—in the neighborhood of twelve per cent. Commutators and brush gear are a little more troublesome, the breakdowns being seventeen per cent for dynamos, and fourteen and one-half per cent for motors. Miscellaneous breakdowns are about the same in both cases, but the motors gave a good deal of trouble with their switch gear, amounting to about fifteen per cent of the total breakdowns, while there was no corresponding trouble at the dynamo end of the system. It seems probable that the lower figures for the failure of other parts of motors, as compared with dynamos, are due to this item of the switch gear; and here again it would seem well to guard against this trouble by using stronger switches for motors.

### *Causes of Trouble.*

The causes of the damage call attention to three factors. The greatest number of breakdowns of both motors and dynamos were from unascertained causes, but aside from this, we find that age and deterioration were responsible for the greatest amount of trouble. Next come bad workmanship and design, these being the cause of about eighteen per cent of the breakdowns for both types of machines. Accidents caused fourteen per cent of the trouble with dynamos, and twelve per cent with motors, while dirt and oil were responsible for ten per cent of the breakdowns of dynamos, and fifteen and one-half per cent of those of motors. The effect of overloading machines was comparatively small, about three per cent. The figures indicate the need for better inspection, both with a view to condemning machines which have, either by reason of their age or lack of attention, become unsafe, and with a view to requiring better care to be taken of electrical machinery. This latter point, as might be expected, applies more particularly to motors, dynamos, as a rule, receiving some sort of capable attention. One might conclude from these figures that it is not sufficient to reverse a dynamo in order to make a good motor. Since the latter will be subjected to harder usage and will receive less attention, it should be more robust, more nearly fool proof.

It is rather surprising to notice in this report the large number of breakdowns due to bad workmanship or bad design. One is inclined to question whether, in some cases, at least, an underrating of the machine was not responsible for the trouble. Where a generating station is supplying a rapidly developing section or a growing factory, overloading is apt to occur, and while this may not cause any immediate trouble, it brings about deterioration, and an inspector who was not familiar with the conditions under which the machine had worked would be inclined to attribute the trouble to bad workmanship or design. This inference is supported by the fact that overloading is reported to have caused but little trouble. On the other hand, a penny wise and pound foolish policy is doubtless responsible for much of the trouble; the man who signs the checks is apt to look carefully at the first cost, forgetting that often a cheap machine gives unreliable service and makes large repair bills.

## BRITISH STANDARDS FOR ELECTRICAL MACHINERY.

The British committee appointed to determine upon engineering standards is making fair progress with its work. Recently it has issued an interim report of the subcommittee on generators, motors and transformers.

### Report Does Not Deal with Details.

In this report no attempt is made to standardize the dimensions or shapes, the recommendations being confined to such points as would ensure uniformity in nomenclature, outputs and test conditions in this work. The conditions obtaining at this time in England were kept in mind and the standards were chosen so as not to throw out any one class of apparatus. To decide upon certain points, experimental work was undertaken; such, for example, as determining the permissible rise in temperature of coils. This work has made sufficient progress to indicate that the temperature limits ultimately recommended by the subcommittee will be more liberal than those which were laid down by either the American or German electrical standardization committees. One point which was determined was that the temperature of the highest part of the coil taken by a thermo-junction is no more than twenty-five degrees centigrade in excess of the mean temperature of the coil.

### Standard Pressure.

In deciding upon pressures and efficiencies no radical change is thought of. The pressures recommended, measured at the terminals of the consumer, are 110, 220, 440 and 500 volts for both direct and alternating currents. For the four-wire three-phase systems with 220 volts between the three conductors and the neutral, the standard pressures will be, of course, 380 volts between the principal conductors. For standard high-pressure alternating-current work 2,200, 3,300, 6,600 and 11,000 volts are recommended for the pressures at the terminals of the generator.

Pressures ten per cent less than these values, measured at the primary terminals of the transformer, are suggested as standard for this class of apparatus. Pressure measured at the secondary terminals of the transformer are approximately five per cent more than those at the consumers' terminals. In all of these values, variations of ten per cent are allowable. The standard frequency recommended is fifty cycles per second; but the secondary standard of twenty-five cycles per second is recommended when the necessity for this lower efficiency exists. This recommendation is rather restricting, as conditions may easily arise where some frequency between these limits will be desirable.

### Machines to Be Marked Plainly.

The committee recommends that the ratings of generators and motors, except traction motors, be marked plainly on the name-plate. Two types of service are recommended, continuous working and intermittent working, and the name-plate must state to which service it relates.

### Standard Speeds.

A list of desirable speeds for various sizes of direct-current generators and motors is suggested, the speeds of the alternating-current generators being, of course, determined by the efficiency and the number of poles in the field. The usual three types—slow, medium and high speed—are recognized and the suggested speeds are in accord with the present practice.

It will be noted in this report that it does not recommend any practice markedly different from that recommended by the American committee. This is, of course, highly desirable since the next step to standardizing the product of one country will be to bring the practice of the different countries into harmony.

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## MEDIUM-SPAN LINE CONSTRUCTION.[1]

BY C. A. COPELAND.

In the past it has been the chief desire of electrical companies to get to the customer with some sort of a line and obtain a swift revenue, while the engineer has not considered it worth his while to spend more than a wisp of his time on line work. The result has been that more than seventy-five per cent of the troubles experienced in the distribution of power, both as to number and cost, have occurred outside the central and substations. The major part of the cost of these troubles has been due to lack of confidence in electricity as a power fund and convenience which does not always show on the books. These remarks apply as well to telephone and telegraph lines and distributing systems as those for light and power.

Not only have lines been excessively troublesome, but they have cost too much. With a view to eliminating both of these faults on cross-country lines, the Edison Electric Company of Los Angeles has been experimenting on several special methods of distributing-system design. The one immediately concerned may be termed medium-span cross-country construction.

The ordinary length of spans, say from 120 to 140 feet, which have been used for the lines, have evidently been transplanted from early days and from localities where snow and ice load the wires to their breaking point even with 100-foot spans. The conditions obtaining around a newly contemplated line should be as carefully studied as those surrounding the hydraulic and central station installations. Transplanted engineering may not always thrive in new soil.

The conditions encountered in the valley districts of southern California are: (1) no snow and ice; (2) a temperature ranging from twenty degrees Fahrenheit at night in winter to 140 degrees in the sun in the summer (that is, a wire will become that hot); (3) occasional severe dry north summer winds which blow hay and mustard stalks upon the lines; (4) frequent interference with lines by wild cats, buzzards, sandhill cranes, mudhens and owls—especially the May and June owls; (5) numerous and almost unavoidable hedges of eucalyptus trees from 50 to 150 feet tall, which, with the assistance of winds, shed twigs and long shreds of bark on to the lines; (6) rapid decay of poles, some rotting off in four years, while the average life is eight; (7) high cost of poles, the cheapest being cedar, and in thirty-five and forty-foot lengths costing from $5 to $10 in the yard.

Experience with bare aluminum cable suggested to the writer that stranded copper cables might be used in long span construction. It was proposed to take good stocky forty-foot cedar poles, space them 225 feet apart, space the wires forty-five inches apart, and employ a sag of from

[1] A paper read before the Pacific Coast Electric Transmission Association, Monterey, Cal., June, 1904.

fifteen to twenty-four inches, depending on the installation temperature. It was designed that a three-phase construction for a voltage as high as 40,000, with one or two circuits of Nos. 3, 4, 5 and 6 cable with single cross-arms, and Nos. 0, 1 and 2 with double cross-arms, should be used.

The longest continuous long-span work previously employed was in Europe on the Palermo-Milan transmission, with solid No. 1 wire and steel lattice work poles spaced 190 feet. In the light of subsequent experience it would seem that if stranded wire had been used the poles could have been made a little heavier and taller and spaced twice as far apart. On the Vizzola-Ticino-Milan transmission, also, steel latticed poles about the same distance apart had been used.

These ideas were received with mistrust. It was argued that in case a wire broke, so and so would happen. But if stranded and carefully installed they will not break. It was also argued that in case the poles rotted the line would be weakened more than if the poles were nearer together. But it would seem that a line should be kept in good repair, whether the poles were many or few, either by letting down five feet or stubbing. An engineer would not buy a boiler with more tubes in it than necessary and let them get in poor repair because there were enough tubes left to keep the boiler safe.

It was argued that in case the top of a pole burned off at the brace, as sometimes happens on the 30,000-volt line, No. 6 wire would not support the weight on a 450-foot span. Accordingly, two experimental spans of 250 feet were constructed and strung with bare solid "second-hand" medium hard-drawn copper, and while it is not necessary to go into great detail in regard to this test, it is sufficient to say that it was amazing the abuse these wires stood before breaking. No. 6 aluminum cable was also tested, and stretched so far before breaking that it also deserves much respect. The stretching factor of safety of copper wire is scarcely appreciated by engineers, and after these tests the writer very nearly recommended solid wire for 225-foot spans. In fact, a European steel pole line employs 246-foot spans with solid No. 2 and 00 wires on forty-foot poles.

The writer knows of no case where a good solid medium hard-drawn wire has broken without a good apparent excuse, such as a burn-off. He has known of such breaks on poor wire which did not come up to the company's standard specifications. The moral is, that with rigid specifications followed by tests, much longer spans with solid copper can be made. We have eight miles of No. 5 line with 150-foot spans, with wire which did not stand a very good test, which has given no trouble.

Stranded copper, however, is superior for 225-foot span work in that: (1) a careless lineman in nicking it reduces its strength less than by nicking a solid wire. A test was made on one cable during which one strand broke at a five-inch sag on 225 feet, but the cable still stood up. (2) Its strength is more uniform throughout its length and therefore a less sag can be safely depended upon. (3) It has a higher strength per square inch because the wires are smaller and are individually stronger. (4) It has a spring effect or untwisting factor of safety. (5) It has a higher elastic limit.

It is believed, but not proved, that stranded copper will not burn off so easily as solid wire on account of its radiating facilities, and because one or two strands will hold the cable intact if the other strands burn off. It costs from eight to twelve per cent more than solid wire of the same conductivity.

Following out these considerations, four miles of experimental line were installed in two sections, one in the Lytle Creek district, near San Bernardino, two miles long, of three-strand No. 5 copper, and the other at Anaheim, of No. 5 seven-strand copper. In the former a 500-foot span was inserted. Otherwise the constructions are identical, and have stood over a year and have passed through the most severe wind storms known in this section for many years. The poles and corner pins now stand perfectly straight, although another new line near-by with 140-foot spans and six wires leans badly from the wind. These medium span lines were, of course, installed with care and by trusty men who have been with the company for several years.

The top cross-arm carrying three cables only; No. 13 Locke oak pins with a bolt centre; two and one-quarter-inch washers under each pin and nut; ordinary deep-groove double-porcelain insulators (selected) with a piece of copper wire netting under each to prevent the burning of pins; three strands of No. 17 medium hard-drawn copper wires twisted together for a telephone cable which was strung on transposition glass insulators and No. 13 Locke pins, and transposed every third pole, were some of the features of construction. Mogul paint was used on all threads, nuts and points of contact of iron and wood and in the gains, and galvanized iron wrapped around the poles under the guy wires. The strand was not allowed to touch the ground and was spliced by twisting with an annealed and flattened copper tube. A double lock tie of No. 8 wire was used with a wood-covered tie wrench; no pliers or come-alongs were allowed on the job. All kinks were eliminated with a splice.

They are both 10,000-volt lines, and the advisability of using deep-groove double-petticoat insulators will be questioned. Seven years' actual service, however, has shown them just as good as any. In fact, there are indications that they are better. They seem to discharge the line without burning the pins. Mechanically speaking, they are superior because the wire is let down closer to the cross-arm. They should, however, be used with caution because the conditions on other systems and localities might not be similar.

The following are representative specifications used for stranded copper cables:

1. This copper cable is to be used for long-span work with 225 to 300-foot span. The cable must be bare and composed of seven medium hard-drawn copper wires. The cable must have a resistance of 0.394 ohm per 1,000 feet; that is, equivalent to No. 6 of 100 per cent Matthiessen's standard conductivity.

2. The cable must have a lay not greater than four inches; that is, one turn of each wire around the cable in four inches of its length.

3. The cables are to be furnished in such lengths that no splicing of individual strands is necessary. When the length of one wire in the strand runs out, the whole cable is to be cut at this point by the manufacturer, to be eventually spliced by means of copper sleeves when the line is constructed.

4. The cable must be pulled through a non-corroding grease bath before being reeled to prevent the chafing of the cable against itself in shipment. Paraffin is suggested.

The strength of the cable must be such that it can be pulled up to a five-inch sag on a 225-foot span. (To be strung with a fifteen to twenty-four-inch sag on the actual line.) In accepting the cable, seven samples will be tested from various portions of the shipment and five must stand a five-inch sag, while two will be allowed to break at this sag. Twenty-five samples of individual strands will be taken from the shipment and given a twisting test, twisted six times on and off its own diameter. In such a test the strands must show absolute uniformity of material and drawing. The surface of these individual

strands must present a good luster and be free from seams, drawing nicks and slivers.

5. Bids are solicited on this cable, manufacturers to specify weight per foot and price per foot.

The writer lays great stress on the old twisting test, as it is found to be an extremely good gauge of uniformity of the product. It is not considered advisable to have a wire of 70,000, 50,000, 30,000, 65,000, 40,000 pounds per square inch ultimate strength at various points along its length. It is more advisable to have it uniformly from 45,000 to 50,000. The twisting test determines this, and in a rough way the tensile strength.

Tests on the seven-strand Anaheim cable and the three-strand telephone cable showed an ultimate strength of 59,500 pounds per square inch, corresponding to a five-inch sag on 225 feet. An actual span was used for the test and remarkably uniform results were obtained, the cable breaking at just five inches sag each time. At five and one-half inches sag the cable had stretched eleven inches in 225 feet, and had a permanent set of 4.6 inches. Subsequent cables have broken uniformly at 63,250 pounds per square inch.

After all, the important factor of this work is, has the engineer "done for a dollar what any fool can do for two," which brings us up to a consideration of comparative cost.

At the time when this matter was first being discussed, five and one-quarter miles of 30,000-volt line was built from Mentone to the new Mill Creek No. 3 powerhouse. The ground was exceedingly rocky, which made the cost of digging holes from $1.50 to $3.30 each, and the cost of stringing and hauling very great, with two three-phase circuits of No. 4 wire, and 125 and 120-foot spans. A saving of sixteen per cent could have been effected by 225-foot medium span construction with cables, and the line would have been safer because the wires would have been forty-five inches apart instead of thirty-six inches. With No. 6 the saving would have been twenty-one per cent, while with No. 3 wire, which is about the practical limit of this kind of work, a saving of eleven per cent would have been obtained.

There is now being constructed nine and one-half miles or more of medium span line in Lytle Creek, near San Bernardino, directly in the path of the severe north winds, of the forty-foot, wood pole, 225-foot span construction, with deep groove double porcelain insulators on 10,000 volts. Half of it is to be strung with No. 5 and half with No. 6 cables, and a saving of twenty-four and one-quarter per cent and twenty-six and one-half per cent will be effected. This is a single circuit line prepared for drawing in another one eventually. In single circuit lines where wire is a smaller percentage of cost the greatest percentage of saving by the longer span is secured.

The company is now building fourteen miles of line from Los Angeles to Inglewood to connect the old United Electric Gas and Power Company's beach town, thirty-eight miles, 17,300-volt transmission system, which the Edison Electric Company has lately acquired, with the 30,000-volt Edison system. This is composed of six No. 4 seven-strand copper power wires strung on a new special porcelain insulator and the three-strand telephone cable mentioned above. Thirty thousand volts will be impressed on the line. The forty-foot poles are of steel and placed 300 feet apart. The cross-arms are of wood because of the danger of birds burning wires off by grounding, but special iron pins have been designed, and all pins are to be grounded together by a fine wire underneath the cross-arm to prevent burning of the wooden parts. The soil is mostly sand, and a cylinder of cement five feet deep is used to set the poles in. Even then the cost is only $48 per mile more than a wood pole line with 125-foot spans, because wood poles would have to be taller than forty feet. If, however, forty-five-foot wood poles and 225-foot spans had been used, the cost would mean an advantage of twenty per cent over an ordinary 125-foot span cedar pole line.

The cost of a forty-foot tripartite pole made by the Franklin Rolling Mill, of Franklin, Pa., in this steel construction, is about $35 f. o. b. Los Angeles, as against $9 for a forty-five-foot cedar pole, so that the above figures are rather surprising. The excess cost of the 300-foot span steel line over the 225-foot span wood line is what the company pays in first cost to prevent depreciation. The advantage is gained that, should the line ever be changed or moved, the poles would be as good as new for a new place. Ordinarily, in such cases, even though the poles are not rotted badly, they are not worth placing again without sawing off. This principle, which is often lost sight of, is especially applicable to city distributing systems.

It will be observed that this construction is especially advisable on lines with small wires, i. e., telegraph, telephone and power lines of Nos. 3, 4, 5 and 6 wire. The percentage saving on single circuit lines is especially great, and the percentage saving is greater the greater the cost of poles and digging holes, and particularly where the poles must be hauled a great distance and when the company must provide tents and eating facilities along the line in building. On high-voltage lines, where the insulators cost considerably, the saving is very patent.

Perhaps the principal mechanical, and therefore ultimate monetary, advantage in medium or long span work is the greatly reduced trouble with insulators and pins, and burning off of poles, and in fact all the troubles which lines are heir to, by making the parts fewer and each better, which, by the way, greatly reduces the necessity for double-pole lines. In other words, make good porcelain eggs and make them larger and stronger than are usually laid, put them in one good strong basket, and watch the basket, and it will not cost so much to watch the basket, either, as it usually does.

It will often be found, especially in this western country, that, by building a line quickly, not only is money saved in construction, but revenue and profit is more quickly obtained or lost power more promptly eliminated. Medium span wood pole lines are built in sixty per cent of the time usually employed on short-span lines.

Medium-span construction would seem advisable also for long-distance telephone and telegraph work in certain sections, and where it is presupposed that a first-class line of long life, and of no trouble while it lives, is the more economical one in the end.

Only in rare instances does the fifteen to twenty inches sag instead of eight make any difference in the height of poles. Private telephone lines should be at least five feet below the lowest power cross-arm, and at least eight feet above the tallest trees, which usually dictates the height of poles. These methods may become important in case a double-pole line is considered advisable where small amounts of power are transmitted at high pressure or small distances.

The question of the preservation of poles from decay is of some importance in this discussion. Granting that a good, cheap, practical method of preserving poles at from seventy cents to $1 per pole can be found—and we are making rapid progress in this direction—the saving by using this medium-span construction is greater than cited above, and entirely removes the question of the greater weaken-

ing of the line by the decaying of poles in the longer span construction.

In conclusion, it may be said that by effecting a saving of from ten to thirty per cent in lines ordinarily costing from $700 to $1,700 per mile, and having from three to twelve of the smaller sizes of wire, a slight advance has been made in the art, in the field of light construction, where the cost of poles, freight and haulage is great, especially as they are better and safer lines than are ordinarily built with more cost, or stating it another way, they are as cheap as the cheapest allowable lines and twice as safe and free from trouble and danger.

## *The Relation of Gas Pressure in a Vacuum Tube to the Length of Spark.*

The relation existing between the gas pressure and the distance through which a spark could jump at very low pressures has been investigated by M. G. Séguy. His work was described at a recent meeting of the Paris Academy of Science. If the pressure exceeds one-hundredth of a millimetre of mercury, measurements may be made by the MacLeod gauge, but if it is less than this the gauge is useless. M. Séguy from his investigation concludes that gas pressures at this high exhaustion can be accurately determined by the distance through which the spark will jump. He has found that if the sparking distance increase in arithmetical progression the pressure decreases geometrically. This shows that the pressure is an exponential function of the explosive distance and hence can be determined by measuring the spark-gap.

## *British Institution of Electrical Engineers.*

The July issue of the *Journal* of the British Institution of Electrical Engineers, just to hand, contains the following interesting articles and the discussions which followed their reading:

"Direct-Reading Measuring Instruments for Switchboard Use," by Kenelm Edgecombe and Franklin Punga.

"Power Station Design," by C. H. Merz and W. McLellan.

"The Steam Turbine as Applied to Electrical Engineering," by the Hon. C. A. Parsons, G. G. Stoney and C. P. Martin.

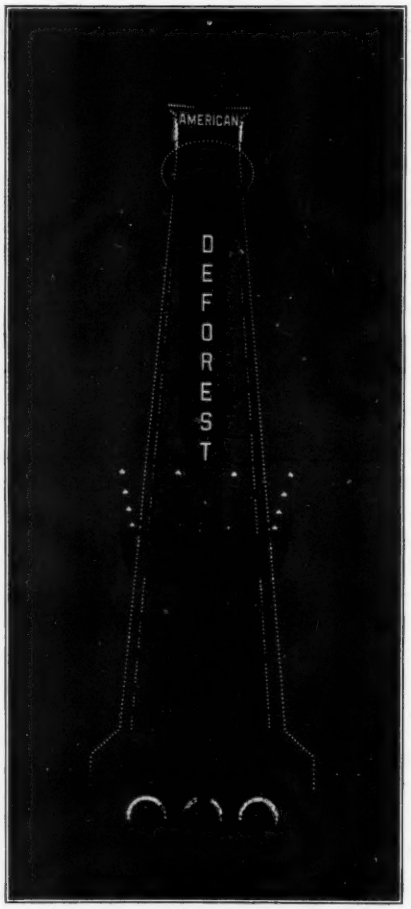
"The Distribution of Electricity in Shipyards and Engine Works," by J. A. Anderson.

"Steam Turbines," by F. C. Porte.

## *OVERLAND WIRELESS TELEGRAPHY AT ST. LOUIS.*

[*By Our Special Correspondent.*]

The experimental work with wireless telegraphy now being done at the World's Fair is of more than ordinary interest, and, should these efforts prove successful, the results will be of much importance. Space telegraphy has been largely confined to the sea or lake shores, but at St. Louis the experiments are all being carried on overland between that point and Springfield or Chicago. The De Forest Wireless Telegraph Company is responsible for the principal experiments,




Observation Tower at Night.

and has established upon the World's Fair grounds ten stations, as well as two others in St. Louis, and one at Springfield, Ill.

The larger stations have been equipped with very powerful apparatus capable of sending messages 300 miles overland. Communication is now maintained between St. Louis and Springfield, a distance of 105 miles, and the same result is expected of the Chicago station now nearing completion. Near the centre of the World's Fair grounds, and at the point of highest altitude, the company has erected a mast 210 feet high, at the top of which is a cross-arm. The arrangement of antennæ at this station is interesting. Strung along a forty-foot cross-arm hangs a horizontal wire, from which twenty verticals are suspended. These antennæ wires average 250 feet in length, and are bowed out from the mast a great distance by means of cord spreaders. The antennæ enter the roof of the building in two halves of ten wires each. Within the building, which is twenty by forty feet, one sees only the operating table, the relay keyboard and receiving instrument. The transformer, condensers, and other paraphernalia are concealed in a separate room. Through a window in the partition, however, one may see the enormous spark which accompanies every signal, but this spark has been so successfully muffled as to be scarcely audible outside of the building. At this station twenty-five-cycle current is the only power available, although a twenty-kilowatt Fort Wayne transformer, built for sixty-cycle, operates very satisfactorily on the lower frequency. There is, however, a drag at the key which would not occur with the high-frequency current. A Wagner motor-generator running on twenty-five cycles is also installed to furnish 110 volts, direct current, in small amount. The direct current is used to operate the relay key which breaks the main circuit. The transformer raises the voltage to 20,000, and the secondary is connected in series with the helix, condenser, spark-gap, antennæ and to ground. The ground-plate consists of 140 square feet of copper plate, buried eight feet directly below the station. Means are provided for maintaining this in a constantly damp condition.

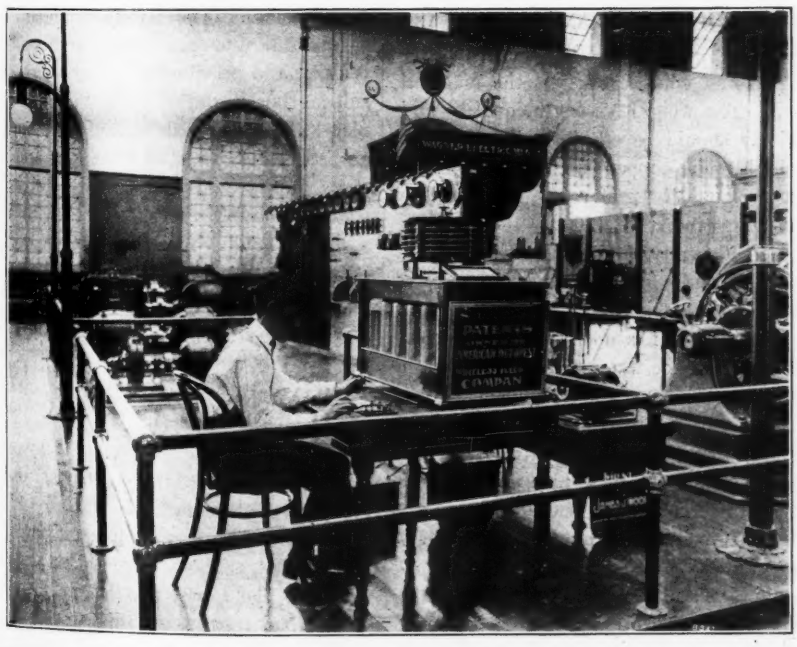
This system was first to employ alternating-current generators and transformers in place of the old induction coil and interrupter used abroad. This enables a far greater speed of transmission, simplicity and regularity of action. Undoubtedly the greatest speeds have been attained by the De Forest system, twenty-five to thirty-five words per minute; in fact, limited, as with wire telegraphs, only by the ability of the operators to send and receive. The rapidity of operation is also due in large measure to the electrolytic receiver peculiar to this system. The principle of this receiver, or "responder," is based upon the fact that the Hertzian oscillations produce sudden electrolytic action in a cell containing certain electrodes and solutions. It was found that receivers so operating were far more sensitive than other forms, being instantly and automatically restored to their natural

state upon cessation of the electric waves. The electrolytic receiver also allows a closer tuning, a greater reliability of action, than any other form. The result is that greater distances are possible with a

Wireless Telegraph Station in Electricity Building, World's Fair, St. Louis.

given transmitting power, and immunity from outside interferences with confusion of messages.

Some very successful work has been done at the exposition with syntonic telegraphy. The operators have been able to attune the receivers to take the messages from any one of the dozen stations in St. Louis. Under this condition the receiving operator may be in communication with a small sending station, unaware of the messages being sent by a long-distance station near-by. In fact, at times, two operators, each with a distinct receiving and tuning apparatus, have been connected to the same receiving wire, one taking messages from one station, and the other from an entirely different station.



Operator Sending Wireless Message, Electricity Building, World's Fair, St. Louis.

Not only has experimental work been carried on at St. Louis, but wireless telegraphy has been placed upon a commercial basis. The newspapers in the city have naturally devoted much space to the events and happenings upon the exposition grounds. Without exception each day brings its quota of celebrated visitors and matters of interest. All this news can be recorded by the afternoon and evening papers only by some easy and sure means of communication. Two of the afternoon papers, *the St. Louis Post Dispatch* and the *St. Louis Star*, have erected wireless masts on top of their buildings and installed apparatus in the press-rooms. The reporters, after gathering the news, go to the De Forest station on the grounds, and the operator calls the office. Copy is sent as quickly and surely as by wire. About 5,000 words a day are transmitted in this way. The most conspicuous station is on the Observation Tower, a steel structure 300 feet high, erected by the De Forest company. The antennæ are strung from a gaff on the roof of the tower, and the wires are gathered in a cable at the station on the 100-foot platform. Here the apparatus is of the same kind and power as that used for the long-distance station on Art Hill. The messages to the newspapers in the city are sent from this point, so that the visitors to the tower may see the commercial operation of wireless telegraphy.

The accompanying illustration shows the main exhibit in the Palace of Electricity, where a model has been erected of the station now in course of construction at Cape Flattery, Wash., for the Alaskan service. Three wooden towers, each seventy-five feet high, support between them the antennæ. These are concentrated into a cable entering the helix, and connecting with the rest of the apparatus. Operators are present at all times to explain and demonstrate the sending and receiving of messages to all visitors. To the public there is a great deal of mystery about communication without wires or other connection. By actually hearing the messages sent and received, the uncanny impression disappears and the commercial possibilities become more apparent to all. P. E. F.

St. Louis, August 27.

### *Weather Notices by Telephone.*

The Pittsburg department of the weather bureau has evolved the idea of sending out daily local weather forecasts by telephone. Farmers of western Pennsylvania, West Virginia and eastern Ohio, as a rule, have telephones in their homes and could be reached in this way by weather reports which, if sent by mail, would hardly be timely. Forecaster Frank Ridgway, of the Pittsburg bureau, is responsible for the innovation.

## POINTS FOR CONSIDERATION WHEN PURCHASING ALTERNATING-CURRENT ARC LAMPS.[1]

BY G. BREWER GRIFFIN.

In introducing this subject, Mr. Griffin discussed the effect of alternating-current arc lamps upon the eye. If the alternations of the arc are too slow, or if the volume of light is either too great or too little, the eye is fatigued. When the proper frequency is chosen and the volume of illumination is within the correct limits, the eye does not absorb the alternations and the light, to all appearances and effects, is steady.

Comparing the illumination given by a 7.5-ampere alternating-current arc lamp with the standard fifty-two-volt 9.5 ampere open arc lamp, the following results are obtained: the minimum illumination between the lamps will be found about the same, though the bright zone given by the open arc lamp is not seen when the enclosed lamp is used and the latter gives the greatest average illumination over the whole area. Alternating-current arc lamps of low amperage, in the author's opinion, are not satisfactory for street lighting. For street lighting the open arc has a decided advantage over the enclosed arc up to 100 feet away from the source of light. At 150 feet and over the alternating-current lamps give the better results. In the author's opinion, 6.6-ampere lamps should be hung eighteen feet above the street level and 7.5-ampere lamps not over twenty-five feet above the street, measuring from the bulb to the street. The author recommends the adoption of slightly opalescent inner bulbs and a clear outer globe. This combination, according to recent investigations, allows over ninety per cent of the light to pass through.

The general practice in lighting seems to be to allow 450 kilowatts for every 300 square feet of street space. It is best to operate lamps with seventy volts as a minimum at the arc and with seventy-five volts as a maximum. Mr. Griffin then discussed the blackening of inner bulbs caused by the positive carbon, itself resulting from incomplete combustion. This may be caused by a lack of oxygen, or by too great a supply of air or the proximity of cool metal parts. It is advisable to use some form of gas cap made of materials which offer a high resistance to disintegration under a high temperature, and which will still dissipate quite rapidly the heat generated by the arc. Attention is called to the pains taken in securing generating apparatus and incandescent lamps of the highest efficiency, while but little attention is paid to this matter in the arc light field.

With this preamble the writer will proceed to take up "Points for Consideration When Purchasing a Series Alternating-Current Arc Lamp Equipment."

For convenience, first consider the lamp itself. The following are the main features in the order given: first of all should be considered the type to be adopted. The higher energy loss in the differential mechanism, in comparison with the shunt, is not to be considered when its superior operation is taken into account. There are variations in this type, however, but the essential details of operation are alike; a pair of series coils, operating against a pair of shunt coils, with a rocker arm or armature connected to the clutch rod. The differential lamp strikes the arc with the carbons together, and the weight of the moving parts holds the carbons apart when no current is passing through the lamp. Troubles and outages caused by the carbons slipping through the clutch do not exist as in the shunt lamp. A lamp of the differential type is, to an extent, self-regulating as to the current taken, which is of direct assistance in the operation of the circuits, and by so doing makes the service good. This is not true of the shunt lamp.

### MECHANICAL CONSTRUCTION—CASE AND TRIM PARTS.

The first consideration is the material used. The weight, strength, quality and rigidity should be carefully investigated. A high-grade copper case, not under 18-gauge, should be preferred. It should be corrugated to give it stiffness and strength and, incidentally, add to the artistic merit.

The second consideration is the accessibility of the mechanism. The case should be provided with a door which is so constructed as to be water-tight and hung on substantial hinges and provided with a good heavy locking device. The door should take up about one-third of the lamp-case and the renewable parts should be easily reached with the door open.

The third consideration is the interchangeability of the parts used. Wherever screws and nuts are used, they should be of standard dimensions and have standard threads, thus making it possible to obtain duplicates from any hardware store.

The fourth consideration is the method of ventilation. The lamp should be well ventilated and still be bug and waterproof.

The fifth consideration is inner bulbs and method of support. The closed base inner bulb is now generally recognized by manufacturers and consumers as best meeting the special requirements for street arc lighting.

The sixth consideration is the outer globes and the method of support. The selection of an entirely closed or open bottom outer globe is one that is largely a matter of personal choice. With some types of lamps the open bottom or outer globe is almost essential, as these lamps use eighteen or twenty-inch external reflectors which are supported by the same device which holds the globe in place. This makes it difficult for the trimmer to handle the globe and shade. Where a suitable inner reflector is used the closed bottom outer globe should be preferred, the life per trim being somewhat longer with it.

The seventh point for consideration is the reflector, where and how supported. Any form of reflector on an outdoor arc lamp is a nuisance and a source of expense. It detracts from the trim appearance of the lamp, and causes the lamp to "sail" in the wind and pack with ice and snow in the winter and dirt in summer.

The eighth consideration should be the lamp cap, hanger loop and terminals. A lamp cap made of copper is preferable to the one constructed of iron or other corrosive metal. The terminals should be substantial and placed as far apart as possible and provided with two heavy and substantial screws to hold the leads in place. The terminals should be mounted on petticoated porcelain insulators and all parts of the lamp cap should be strictly water-tight and no part exposed to the weather should be made of any material other than gun metal, brass, phosphor bronze, copper or similar metal. Thus the periodical refinishing and painting of street arc lamps is avoided.

### MECHANICAL CONSTRUCTION—MECHANISM.

The next group of features to be considered should be the mechanical construction of the mechanism.

First—the number of different parts or pieces used. These parts should be reduced to the lowest possible number, in order that repairs may be quickly and easily made and a large stock of supply parts unnecessary.

Second—assembly of parts. The parts of the lamp should be readily detachable one from the other without disassembling the entire mechanism. Preferably, all parts should be mounted on a spider at-

[1] Abstract of a paper read at the tenth annual convention of the Ohio Electric Light Association at Sandusky, August 17.

tached to the central tube, which tube should be especially heavy. This method of construction would allow the entire mechanism to be removed from the lamp case with the central tube. The central tube should, however, be readily detached from the rest of the mechanism. This method of mounting would preserve the alignment of the lamp under all conditions, as the tube would screw into a substantial cross-bar in the top of the lamp and line up with bushings in the base frame so that it would be practically impossible to reassemble the lamp and have it out of alignment.

Third—methods of adjustment. Easy and rapid methods of adjustment should be provided. One of the adjustments most used is necessarily the cutout weight and contacts. Some method should be provided, so that close adjustment of the arc can be readily obtained without the weight sliding back and forth on the bar as the rocker arm is tilted.

Fourth—quality of material used. Central station buyers should insist on a high grade of material throughout. The first cost might be slightly more, but the decrease in annual maintenance charges would be marked, and the depreciation charge on the apparatus could be reduced, as the valuable life of the lamp would be increased in the ratio of the quality of the material used.

Fifth—switch construction. The switch preferably should have no moving leads attached to it. The contact parts should be well made, and the handle projecting on the outside of the case preferably metal.

Sixth—magnet spools; material used and how constructed. The use of metal spools covered with paper or any similar material of this kind, while used to a great extent by some manufacturers, is not to be considered the best practice in alternating-current arc lamps. A magnet spool should preferably be moulded in one piece from some of the well-known insulating materials, preferably "vulcabeston." All spools should be interchangeable one with another. The windings should show careful workmanship, the layers being smooth and the leads attached and connected where necessary with two screw sleeve connectors.

Seventh—cutout device. The cutout should be so constructed that it is only necessary to bridge one contact to cut out the lamp. This contact should be faced with coin silver, which metal will not lump up should there be any tendency for the cutout to arc, and its oxide is a good conductor. The arms should be readily renewable, and be so attached that they are rigid when put on.

ELECTRICAL PERFORMANCE.

First—breakdown tests. The best engineering practice to-day demands that a series alternating-current arc lamp should be able to withstand a breakdown test to ground without damage to the insulation of 7,000 to 8,000 volts, alternating current, applied for one minute. Careful buyers are insisting that some guarantee be given as to what tests lamps of this character will withstand.

Second—losses in mechanism. If a differential lamp is carefully constructed, electrically and mechanically, the loss should not exceed twenty-two watts per lamp. The efficiency varies somewhat with the carbons used. The figures above given should be the average with a number of pairs of carbons. The ideal way to make such a test is to select from twenty-five carbons those which gauge between 0.505 and 0.520 of an inch, resort them after gauging, and select by weight those which come between the heaviest and the lightest; or, in other words, the average weight carbon. Twenty readings should be taken at five-minute intervals with each pair of carbons, after first allowing the arc to establish itself and burn not less than one-half hour before taking the first reading. Take the same number of readings on the other six pairs, then break them on the holder ends so that the arc will form one-third down the inner bulb. Again break them to a point one-half the way down, taking the same readings. At two-thirds the way down the same readings should be taken. The average results obtained under these conditions will be extremely accurate, and with some differential lamps the writer has obtained a loss as low as nineteen watts average.

Third—power-factor. The power-factor does not appreciably vary with the location of the arc in the enclosing chamber, but will vary with the quality of the carbon. Many central station lamp men and manufacturers erroneously estimate that the power-factor of a pair of carbons, without intervening mechanism, is 100 per cent. Actually, the power-factor under these conditions is about ninety per cent. This percentage must, therefore, be taken as the ideal condition as to maximum power-factor obtainable with the alternating-current arc lamp. The prospective buyer should insist that the manufacturers provide him with a written performance specification in which there is stated what results will be obtained and what will be guaranteed by the manufacturer. Competitive specifications should be carefully analyzed.

Fourth — arc voltage regulation. Through a twelve-hour run the variation in arc voltage should not be over five volts, and the variation from the pick-up to point of feed should not be over fifteen volts.

Fifth—temperature. The longevity and the value of the insulation is increased by low temperature. The copper shell lamp usually maintains a cooler mechanism than does the iron case lamp, owing to the high heat conductivity of the copper. The temperature of the mechanism should not be in excess of forty-five degrees centigrade after twelve hours' continuous operation; however, it goes without saying that sixty degrees would not damage the insulation, although the life of the material would be shorter than on a lamp operated at forty-five degrees rise.

COMMERCIAL PERFORMANCE.

First—ratio of life to light. Extremely long life can only be obtained by operating lamps with either a low-voltage arc or with the barest possible amount of arc ventilation, and it is usually obtained at the expense of light and power-factor. With a 6.6-ampere series alternating-current lamp the most satisfactory rate of consumption is about one-tenth of an inch of carbon per hour, giving a life per trim, using twelve-inch upper and seven-inch lower carbons, of about 100 to 105 hours.

Second—efficiency. The efficiency of the alternating-current arc lamp depends largely upon the length and diameter of the carbons used, the current density and length of arc. This is usually calculated by the ratio between the true watts at terminals and the true watts at the arc. A lamp carefully designed and free from undue friction in the parts, having the proper amount of iron in magnet cores, should not show a loss of over twenty-two to twenty-five watts.

Third—light efficiency for fifty hours. The writer has previously referred to the advantage of having a cool gas cap, and thereby causing the by-product of the carbon to deposit thereon rather than on the inner surface of the bulb. With a gas cap, as recommended, the available life obtainable when the arc is half way down in the bulb would be fully fifty per cent greater than should some form of metal gas cap be used.

Fourth—distribution or diffusion of light from arc. A reflector should be so designed as to interrupt the upward ray

when the arc is at its average distance away from the reflecting surface. Working with this idea in view, arc lamp designers should be able to design a lamp with a satisfactory reflector which would not be over eight or nine inches in diameter.

Fifth—noise. There should be little or no noise from a properly designed and well made series alternating-current arc lamp if no loose parts exist. With a lamp hanging fifteen feet above the street no noise should be noticeable. There is, of necessity, even in the very best lamp that could be designed, a very slight hum at the arc. This hum should be so slight as to require an effort to detect it.

COMMERCIAL OPERATION.

First—amperage to be used. It will usually be found satisfactory to replace the nominally rated 1,200-candle-power open lamp with 6.6-ampere series alternating-current lamps which consume about 410 watts at the arc. Where the so-called 2,000-candle-power lamps have been in use it is usually customary to replace them with 7.5-ampere series alternating-current lamps, using about 518 watts at the arc.

Second—height to be hung from street and distance apart. The writer recommends that 6.6-ampere lamps be hung eighteen feet and 7.5 lamps not to exceed twenty-five feet above the street level. This, however, is a point that almost every central station man has to decide upon to meet his own requirements and conditions.

Third—how best to light streets having heavy foliage. When the trees have not attained growth sufficient to make it impracticable to light over their tops when lamps are placed on twenty-foot poles, this method is recommended; but as the trees usually have attained growth much beyond this, the most satisfactory would be to trim out the limbs on the street side of the tree to a height of at least twenty feet from the ground. Set the poles in line with the trees, using long cross-arms well braced to the poles, putting the cross-arm so that practically its entire length will overhang the street, rather than endeavor to run the wires through the limbs, then hang the lamps on cable supports with pulleys and cord. Where municipalities or state tree wardens will not allow the trees to be thus trimmed, run the wires through the trees, endeavoring to keep them as free from grounds as possible, and hang the lamps low enough so that the light from them will not be obstructed by overhanging foliage.

Fourth—line fittings. In general, the writer would advise that nothing smaller than No. 6 line wire be used; No. 4 is preferable. Anything smaller than No. 6 has not sufficient tensile strength to prove entirely satisfactory. It is usually good policy to buy fittings which are substantially constructed and made of good material. The use of an absolute hanger cutout is advisable, although not deemed absolutely necessary by some engineers. The lamp trimmer can work much more rapidly when he knows that the lamp he is handling is dead from the binding-post down, and it goes without saying that he stands much less chance of injury due to accident crosses between the alternating-current day service lines and the arc lines.

The next point to be considered is the method of regulating the arc circuits. In checking over the installations of series alternating-current arc lamps throughout the United States it will be found that in the majority of cases there has been adopted a regulating transformer which is known as the repulsion coil arc regulator or tube transformer. This device has met with universal approbation, and very few instances are on record where anything but highly successful operation has been given by it.

COMPARATIVE ADVANTAGES.

In the writer's opinion an air-cooled regulating transformer is the most satisfactory for sizes of twenty-five and fifty-light capacities, and 100 lights when the circuits in the transformer are entirely separate from each other. I think the choice applies quite as well for the seventy-five-light regulating transformer where the secondaries are interconnected. As there is no great trouble experienced with the insulation at the maximum voltage obtainable, the air-cooled regulator has the better opportunity of operating at the minimum internal temperature than has the oil-cooled. A good air-cooled regulating transformer should be surrounded by a perforated metal case, or a wire-mesh case, which is readily removable, and which, when on, allows a complete view of all parts of the regulator. Air-cooled regulators are usually fitted with oil dashpots, while with the oil-cooled the coils working in the oil move so sluggishly that the dashpot is not necessary.

The air-cooled regulator usually regulates somewhat closer than does the oil-cooled for the foregoing reasons. However carefully the case is made for the oil-cooled regulator there is bound to be some leakage of oil. The oil-cooled regulator is more difficult to inspect, and if for any reason a regulator coil burns out or becomes damaged it is considerably more trouble to replace the coil than it would be in the air-cooled type. Both of the leading companies now use the vacuum process of impregnation, which entirely eliminates troubles due to absorption of moisture and loosening of the winding. In two-circuit 150-light regulators, or two-circuit 200-light regulators, or single-circuit 100-light regulators, the writer would be inclined to select the oil-cooled type owing to the high voltage incident to the operation of circuits of this size.

These regulating transformers are so designed that they maintain a constant current from full load to dead short-circuit when the regulator is connected with the highest secondary tap. It is now the practice to wind the coils with, usually, three taps made in each so that the regulators are capable of operating at partial loads with practically the same power-factor and a very slight change in efficiency. This is particularly handy to the central station man who desires to purchase an equipment for use where he has thirty lamps in service and expects eventually to increase to fifty lamps; thus, he can purchase the fifty-light regulator and operate it with practically as good economy as a thirty-light regulator built for the purpose and has immediately available excess capacity to take care of any additions made to his circuits.

MECHANICAL CONSTRUCTION.

The points to be considered are strength, accessibility, amount of friction in moving parts, adjustability to load conditions with maintenance of high efficiency and power-factor, compactness and noise. While it is doubtful if repairs would ever be necessary, it is well to have the apparatus so designed that repairs may readily be made at the central station and by the central station force. If the iron is laid up carefully and held securely in place there should be very little noise from the regulator. All parts of the frame-work should be solid and substantial, and the quadrants or wheels supporting the counterweights should of preference be mounted with ball-bearings.

ELECTRICAL CONSTRUCTION.

The points to be considered are: coils, how insulated and how supported. Attention should be given to amount of space between coils and case, in order that breakdown voltage may be high, as well as space between floor and case, which

should be great enough to prevent accumulation of dirt and dust under the regulator. The parts of the regulator carrying current should be guarded from accidental contact to the operators and attendants, and still be sufficiently open to allow good ventilation.

ELECTRICAL PERFORMANCE.

The purchaser should obtain from the manufacturer guarantees as to what breakdown tests his apparatus will withstand; percentage of regulation through the range of action; efficiency and power-factor on various percentages of load on each one of the various taps brought out from the coils. When starting a current it is advisable to use some form of a block in the regulator arm or spoke of the regulator wheel, which can be set during the day when the regulators are inspected, and which will fall out by gravity when the load is thrown on to the regulators. It is good practice to set the regulators in the station so that there will be ample space to walk entirely around them, so that no excuse can be given by the attendant for allowing dust and dirt to accumulate on or about them.

CONTROL PANEL.

It is good practice to have a dead-beat ammeter on each circuit in order that at any time condition of operation may be noted, and troubles on the line observed as soon as they occur. A good double-pole, single-throw, oil switch is a convenient and useful thing to have on each circuit in addition to the circuit plugs. Where two generators are used carrying both house lighting and street lighting services, it is well to have double-throw switches so arranged that the entire load may be thrown on to one machine at an hour after midnight when the load will admit of it. The use of fuses on each circuit, together with lightning arresters and choke coils, is advisable. It is usually customary to erect a panel in front of each regulator whose circuits are controlled by it. The system above laid out is the one best fitted to meet all the complex requirements and conditions surrounding central station street lighting services. Where a number of incandescent lamps are required to light courts and back streets or alleys, series incandescent street lamps fitted with parchment cutout bases may be tapped in series with the arc lamps and highly successful operation obtained. It is understood, of course, that the amperage of the incandescent lamps should be the same as the arc circuits upon which they operate.

It is hard to conceive a simpler system which would be as free from mechanical and electrical complexities, and as flexible as the one above laid out.

## *Foreign Electrical Notes.*

Consul Warner, of Leipzig, Germany, writes on the following points of interest to electrical engineers and manufacturers of electrical and allied machinery:

Tenders are invited for three three-ton electric cranes and two electric locomotives for use by the London Electric Works at Greenwich. Detailed information may be obtained at the County Hall, Spring Gardens, London, S. W., England, upon payment of the sum of £2.

The Electric Street Railway Company, of Genoa, has decided to extend its present sytem of lines and to purchase a considerable quantity of rolling stock, chiefly motor cars. It is proposed to build an electric road between Aquila and Teramo, cities which are located in the Abruzzie Molise Compartimento, Italy, about thirty-five miles apart. Detailed information about this road may be obtained from Cav. Camerini, sindaco (mayor) of Aquila.

The city council of Kalk Bay Station, Cape Colony, has been empowered to issue bonds for a sufficient amount to erect a municipal electric light and power plant.

The Sociedad Tranvias de Saragossa, Spain, has requested the city council for the concession to make several extensions of its present system of tracks. It is rumored that the concession will be granted, in which case the railway company will have to purchase rails and additional rolling stock.

The Schaffhausen-Schleitheim Electric Railroad Company, of Schaffhausen, Switzerland, is reported to be in the market as a purchaser of rolling stock.

The management of the electric light and power plant of Christiania, Norway, will soon have to purchase electrical machinery and cables, it having been practically decided to enlarge the capacity of the plant.

On August 4, 1904, the city authorities of Fuentes de Andalucia and Iznajar awarded contracts for the construction and twenty-year management of electric light and power plants.

The city council of East Retford, a city of over 10,000 inhabitants in Nottingham County, England, is contemplating the building of a municipal light and power plant.

The municipal council of Rochdale, a borough of about 75,000 inhabitants in Lancashire County, England, is planning to spend a sum in excess of $200,000 in enlarging and improving its electric plant.

The municipal authorities of Barcellos, a small place on the Cavado river, about twenty-five miles north of Oporto, Portugal, are willing to grant a thirty-year concession to a company for the erection of an electric light and power plant. One of the stipulations which will be exacted of such a company will be that it furnish the municipality with 160 sixteen-candle-power incandescent lights and six fifty-candle-power arc lights for the sum of 1,500 milreis ($1,620) per annum.

## *Loss of Power from the Contact Resistance of Carbon Brushes.*

At a recent meeting of the Physical Society at Zurich, M. Schenkel detailed certain investigations which he has been making as to the resistance of carbon brushes. The measurements were made at the laboratory of Professor Weber, and the apparatus used consisted of a bronze slip-ring upon which two carbon brushes were pressed. The ring was revolved at constant speed. These tests have enabled the investigator to lay down the following laws: with a constant brush pressure of 0.08 kilometre per square centimetre of surface contact and with a constant peripheral speed of 7.5 metres per second, the curve giving the contact resistance as a function of intensity, is very nearly equivalent; RI is equal to the constant. For a given current density and pressure the resistance is independent of the peripheral speed, provided the slip-ring is accurately centered. If it be eccentric in the least the contact resistance increases rapidly with the speed. The curve which gives the resistance as a function of the brush pressure is similar to that given it as a function of current density; that is to say, PRI = a constant, P being the pressure of the brushes. It is, therefore, advantageous to increase the brush pressure since this diminishes the contact resistance, but, on the other hand, it increases the brush friction.

Schenkel has observed that the contact resistance was slightly affected by the temperature. It is affected very slightly by the Pelletier effect. The resistance is due principally to the fact that the carbon and metal are not in perfect contact, there being always a thin layer of air interposed.

## *A New Magnetic Observatory.*

The observatory to be built by the British government to replace the one at Kew for magnetic observations will be begun at Eskdalemuir, Dumfriesshire, very shortly. The contracts already let embrace the making of a road and foundations, provisions for water supply and the building of a boundary wall, to be carried out within three months. It is expected that after this start the work will progress rapidly.

### *List of the Domestic Jurors in the Electricity Section of the International Jury of Awards of the Universal Exposition, St. Louis, 1904.*

The following list of domestic jurors has been appointed in the electricity section of the international jury of award of the Louisiana Purchase Exposition:

GROUP 67—MACHINES FOR GENERATING AND USING ELECTRICITY.

W. V. N. Powelson, assistant general manager Union Electric Light and Power Company, St. Louis.

H. B. Smith, professor electrical engineering, Worcester Polytechnic Institute, Worcester, Mass.

M. H. Gerry, chief engineer of Missouri River Power Company, long-distance transmission plant, Canyon Ferry, Mont.

O. T. Crosby, consulting electrical engineer, 43-49 Exchange Place, New York city.

C. W. Wason, president Central Pacific & Eastern Electric Railway, Cleveland, Ohio.

J. P. Jackson, professor electrical engineering, Pennsylvania State College, State College, Pa.

G. F. Baum, professor electrical engineering, Stanford University, Cal.

P. O. Keilholtz, general manager United Electric Light and Power Company, Baltimore, Md.

E. P. Roberts, consulting electrical engineer, 602 Electric Building, Cleveland, Ohio (formerly professor of electrical engineering, Cornell University).

R. B. Owens, professor electrical engineering, McGill University, Montreal, Canada.

G. F. Sever, professor electrical engineering, Columbia University, New York city.

J. W. Esterline, assistant professor electrical engineering, Purdue University, La Fayette, Ind.

H. H. Norris, assistant professor electrical engineering, Cornell University, Ithaca, N. Y.

GROUP 68—ELECTROCHEMISTRY.

Carl Hering, consulting electrical engineer, 929 Chestnut street, Philadelphia, Pa. Member of international juries of award of several expositions in Europe, including Paris, 1900.

Dr. Samuel Sheldon, professor electrical engineering, Brooklyn Polytechnic Institute, Brooklyn, N. Y., vice-president American Institute of Electrical Engineers.

C. F. Burgess, professor electrical engineering, University of Wisconsin, Madison, Wis.

GROUP 69—ELECTRIC LIGHTING.

F. E. Drake, president Lanyon Zinc Company, St. Louis.

E. L. Nichols, professor of physics, Cornell University, Ithaca, N. Y.

Paul Anderson, professor electrical and mechanical engineering, Kentucky State College, Lexington, Ky.

G. D. Shepardson, professor electrical engineering, University of Minnesota, Minneapolis, Minn.

C. A. Adams, professor electrical engineering, Harvard University, Cambridge, Mass.

Henry Floy, consulting engineer, 220 Broadway, New York.

B. V. Swenson, assistant professor electrical engineering, University of Wisconsin, Madison, Wis.

Warren E. Weinsheimer, 159 Adams street, Chicago, Ill.

GROUP 70—TELEPHONY AND TELEGRAPHY.

A. E. Kennelly, professor electrical engineering, Harvard University, Cambridge, Mass.

W. J. Hammer, consulting electrical engineer, 26 Cortlandt street, New York city.

J. C. Kelsey, professor telephone engineering, Purdue University, La Fayette, Ind.

A. S. Langsdorf, professor electrical engineering, Washington University, St. Louis.

GROUP 71—VARIOUS APPLICATIONS OF ELECTRICITY.

C. R. Cross Thayer, professor of physics, Massachusetts Institute of Technology, Boston, Mass.

Dr. William J. Morton, 19 East Twenty-eighth street, New York city.

T. B. Rosa, physicist, Bureau of Standards, Washington, D. C.

Lieutenant-Colonel Samuel Reber, United States Army, Washington, D. C.

F. A. Wolff, professor physics and electrical engineering, Columbian University, Washington, D. C.

Frederick Bedell, assistant professor physics, Cornell University, Ithaca, N. Y.

Captain N. C. Buckey, war department, Washington, D. C.

Dr. K. E. Guthe, physicist, Bureau of Standards, Washington, D. C.

### *The International Association of Municipal Electricians.*

The ninth annual convention of the International Association of Municipal Electricians will be held at St. Louis, Mo., September 13 and 14, 1904. The Grand View Fraternal Hotel has been selected as the official headquarters for the convention. The secretary will be in attendance on Monday, September 12, and members and guests should register as soon as possible after their arrival. The opening session will be held at 9.30 A. M., Tuesday, September 13, in the meeting room of the hotel.

Messrs. William H. Brandt, F. C. Mason and William Petty have been appointed delegates to attend the sessions of the International Electrical Congress.

On Thursday, September 15, a joint session of the International Association of Municipal Electricians and section G of the congress will be held. This section is devoted to electrical communication, and papers of interest and importance to the municipal electricians will be discussed.

### *Electrician for the Custodian Service, Brooklyn, N. Y.*

A civil service examination to secure eligibles for a position as electrician in the United States courthouse and post office at Brooklyn, N. Y., will be held in that city on September 21. This position pays $1,000 a year, and it is possible that other similar vacancies may occur in the custodian service at that place.

The subjects of the examination will be letter writing, practical questions and experience. The age limit is from twenty-one to fifty years, and the applicant must not be disqualified physically. While the examination is open to all citizens of the United States who comply with the requirements, preference will be given to residents of the city and county in which the vacancy exists.

Applicants should apply at once to the secretary of the board of examiners at the Custom House, New York city, for application form 1052. This form when properly filled out must be filed with the secretary at New York on or before September 16.

### *The Street Railway Accountants' Association of America.*

The eighth annual convention of the Street Railway Accountants' Association of America will be held at St. Louis, Mo., Thursday, Friday and Saturday, October 13, 14 and 15, 1904. The headquarters of the convention will be the Inside Inn, located within the grounds of the exposition. Part of the programme will be a joint consideration with the American Railway, Mechanical and Electrical Association of a subject interesting to both associations. Another part of the programme will be an expansion of the question box idea, and this, it is believed, will prove one of the best branches of association work.

# The Automatic Telephone System at Los Angeles, Cal.

*Description of the New Equipment of the Home Telephone and Telegraph Company.*

By P. K. Higgins.

LOS ANGELES, Cal., a city of 125,000 inhabitants, is making, by the introduction of the Strowger automatic system, its initial bow to the modern improvements in the telephone art. The pioneer in this part of the world is the Independent Home Telephone and Telegraph Company, of Los Angeles, and while now possessing one of the largest and finest manual equipments ever installed in any city, has shown its willingness to adopt modern methods, by introducing the comparatively new automatic exchange. One of the greatest drawbacks to an efficient telephone system on the Pacific coast has been the trouble of securing good and efficient operators. This difficulty is also experienced in the East, but not to the same extent as felt on the Coast, because of the fact that young ladies so employed are much more independent, and ninety per cent of them are of a transient character, being only here temporarily and not stating this fact until after they have been employed some time and initiated into the mysteries of the telephone switchboard. The introduction of the automatic is partly due to this fact, and also to a desire of the board of management to install nothing but the finest and most modern apparatus.

Mr. John Van Liew is the general manager of the company. Not only is he a good business man, but he possesses a fair knowledge of the technical end of the business. He is progressive, liberal, and has not only the good will of the board of directors, but also of those serving under him; being just in his dealings both with the public and his employés. These characteristics, combined with the confidence of the board of directors, and his willingness to meet the demands and wishes of the public, have made the Los Angeles system famous as the mushroom plant, because of its phenomenal growth in the comparatively short time of one year of business. The main exchange of to-day boasts of 9,120 main lines, 411 private branch exchange trunks, 15,301 instruments and seventy-four private branch exchanges, having from 10 to 250 lines each. There is also a private exchange in the neighboring suburb of Hollywood, having in service 132 main lines. This exchange, being six miles from Los Angeles, is connected with that city by means of ten trunk lines. It has a manual board, full central energy, and is giving excellent service. This company after one year's experience with the Kellogg manual board, and after having fully and thoroughly investigated all other manual systems, has decided to adopt the automatic system in its entirety. A branch exchange, located at 1932 South Grand avenue, with 4,000 lines equipped, and an ultimate capacity of 8,000 lines, has been installed, and it is expected that this will be in full operation in August, 1904. Similar equipments will be installed between now and January 1, 1905, at Boyle Heights, Highland Park, Vernon and East Los Angeles. The buildings are now being erected and the contract for the equipment has been let (through Mr. C. P. Platt, its efficient representative on the Coast) to the Automatic Electric Company, of Chicago, Ill. The automatic system is also being installed at San Diego, Cal., and contracts for several other points will be closed within the next thirty days. The installation of the automatic exchange at San Diego is under the general management of Mr. F. F. Graves, of Los Angeles, the pioneer contractor and builder of independent plants on the Pacific coast.

The management of the Home Telephone company, of Los Angeles, consists of Colonel J. M. C. Marble, president; A. B. Cass, vice-president; Herman W. Hellman, treasurer, and J. S. Torrence, secretary; Thomas W. Phillips, F. F. Graves, W. C. Patterson and Oscar A. Trippett being directors. All these men are good business men, and are well known and highly respected by the people of Los Angeles. This fact has also had its bearing on the success of the Home Telephone company during the past year.

It is confidently expected that there will be in the neighborhood of 30,000 telephones connected to the Los Angeles system on or before January 1, 1905, being a total of 18,000 main lines, and the balance extension telephones and private branch exchanges. Each one of the sub-exchanges is expected to carry an average of 3,500 main lines. The accommodations at the main office have already been made and equipment installed for 200 incoming and 200 outgoing trunk lines. There is an average of 97,510 calls per day handled in the main office of the company and 850 toll connections per day. There are nearly sixty toll stations connected with twenty-five toll lines entering the Los Angeles exchange, and taking up the entire time of six operators during the busy part of the day.

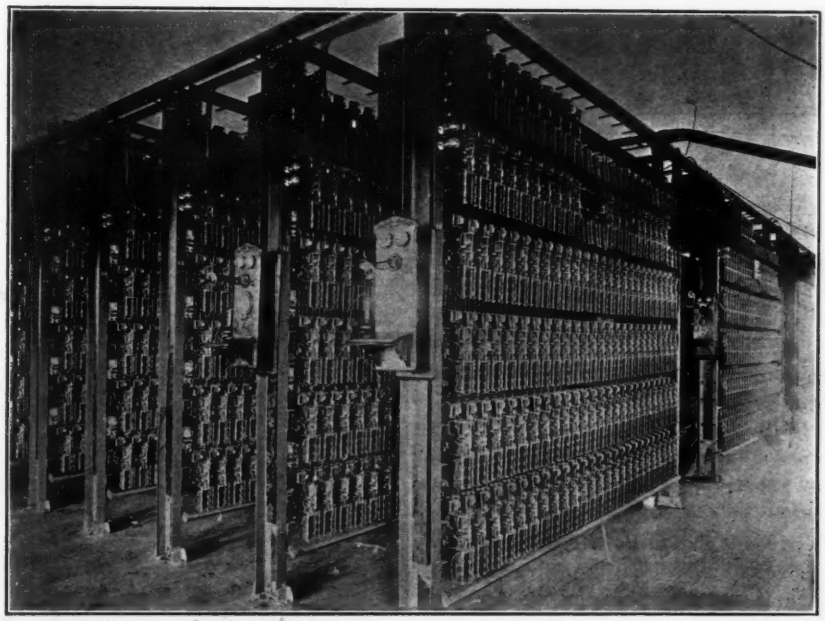


FIG. 1.—SECTION OF MAIN EXCHANGE, SHOWING SELECTORS AND CONNECTORS, AT LOS ANGELES.

The first and basic patent in the devel-

opment of the automatic system was taken out by Connelly and McTighe in 1879, followed by A. B. Strowger in 1891, Keith in 1892. On November 3, 1892, the first exchange in the automatic system was installed at La Porte, Ind., and was visited by the writer. Each subscriber's telephone required five lines leading to the central office, and while it was a miserable failure, the possibilities of a great and useful system could easily be seen in the crude apparatus as installed at La Porte. Late in 1894 Messrs. Strowger and Keith were joined by Ericsson Brothers, they forming the Strowger Automatic Electric Company. Their first effort was in 1895, when they rebuilt the La Porte exchange. This was again remodeled in 1897, and was followed by an installation at Augusta, Ga., and Auburn, N. Y. The trunking system, which is now being used very extensively in systems having more than 1,000 capacity, was not introduced before the spring of 1899. In the fall of that year this system was introduced at New Bedford, and a little later at Fall River, Mass., this exchange being operated and managed by the Eastern Automatic Company, of Boston, Mass.

The above brief history brings us up to about the year 1902, when the installations were begun for Chicago, Dayton and Grand Rapids exchanges. At the present writing we find the automatic being installed in many representative cities all over the country.

Interest is also being awakened in Europe as to the possibilities of the automatic, so that from this it will be seen that Los Angeles is not the only system falling in line with the modern development in the telephone art.

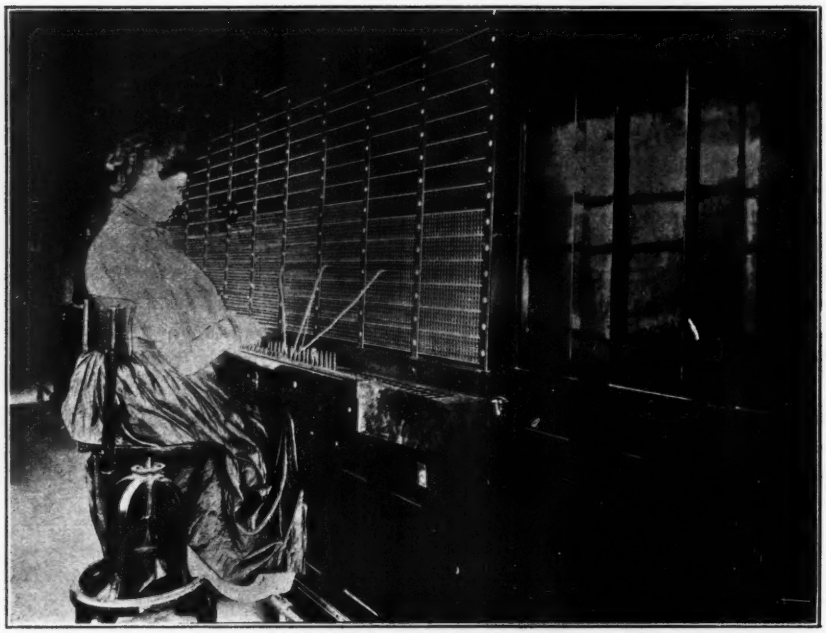


FIG. 2.—TRUNKING SECTION FOR CALLS FROM MANUAL TO AUTOMATIC SYSTEM AT THE LOS ANGELES EXCHANGE.

The equipment used at the subscriber's end of the automatic system consists essentially of a complete local battery talking circuit, having the customary transmitter, receiver, induction coil, battery and receiver hook used in the manual system. In addition to these there is also provided a special calling mechanism mounted on two metal plates held apart by metal rods; the lower plate of the movement being fastened to the door of the instrument on the inside. The shaft common to both sides of the door extends through, and projects on both sides of the door. On the front is an indicator numbered from 1 to 0, also a long-distance point. In front of each number or unit is a hole; this is used by the subscriber for pulling the dial down to the stop in order to send in his call to central. A strong clock spring is also provided for returning the dial back to its normal position. At the lower end of this indicator, or dial, is a stop or trigger, and below this is a number plate containing the telephone number and the ringing button. Inside the instrument proper, and between the plates mounted on the door, is a section of a wheel having cut in it eleven teeth, ten of these move in one plane and the eleventh in another, the two movements being about one-half inch apart. In the same space occupied by these movements is a neatly devised governor consisting of a small wheel in two parts geared from 1 to 20 and used to regulate the speed of the shaft. There is also provided a rotary impulse spring which is worked by the eleventh tooth. A vertical impulse spring is located in the path of the other ten teeth, and is so arranged as to be engaged by each tooth and released after the tooth has passed. The act of sending in a number places the corresponding number of teeth so that they must strike the impulse spring on their way to normal. The hook is provided

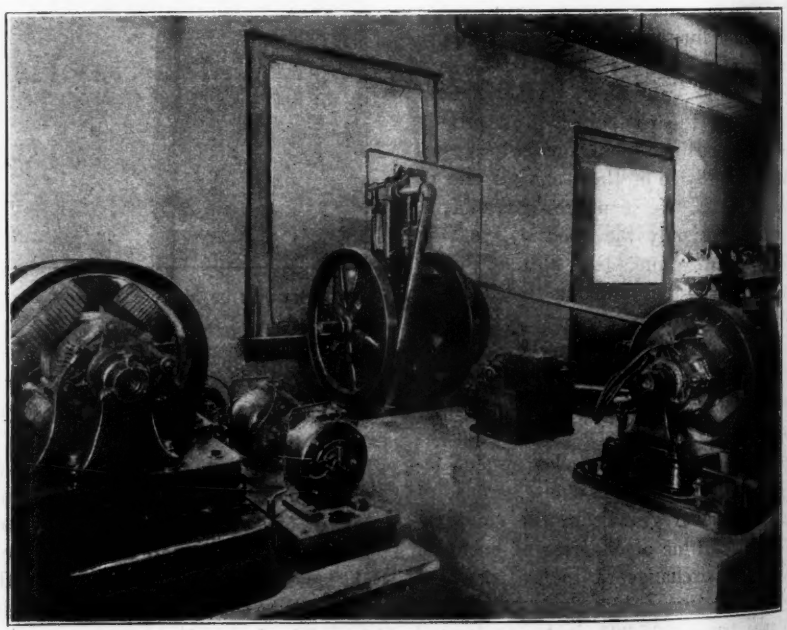


FIG. 3.—GAS ENGINE, AIR COMPRESSOR, CHARGING AND RINGING MACHINE, LOS ANGELES.

with an extension which engages five talking springs, the two lower of which are used to close the local battery circuit. There is also an extension attached to the shaft which engages the same springs. The subscriber in order to make up the number desired, for example 64 (in a series system), would place his finger in the hole opposite the figure 6 and pull the dial down to the stop, release his finger, and immediately the clock spring returns the dial back to normal in a leisurely manner, being controlled by the governor already mentioned, and in doing so these six teeth then engaged caused the vertical spring to ground the vertical line six times, and the rotary spring to ground the rotary side of the line once. The movement is now repeated by placing the finger in the dial opposite digit 4, repeating the former movement, this time, however, only giving four pulsations on the vertical side and one on the rotary. The movement varies slightly in the different systems, according to the capacity of the exchange.

The act of turning the dial by the subscriber breaks the line connections at the talking springs and at the same time moves the impulse teeth over to the left of the impulse springs (no contact, however, being made at this time), so that in returning the impulse springs are engaged just as many times as there are teeth to pass. The act of taking down the receiver disconnects the substation bell (or ringer) from the line, and calls can only be sent to central with the receiver off the hook.

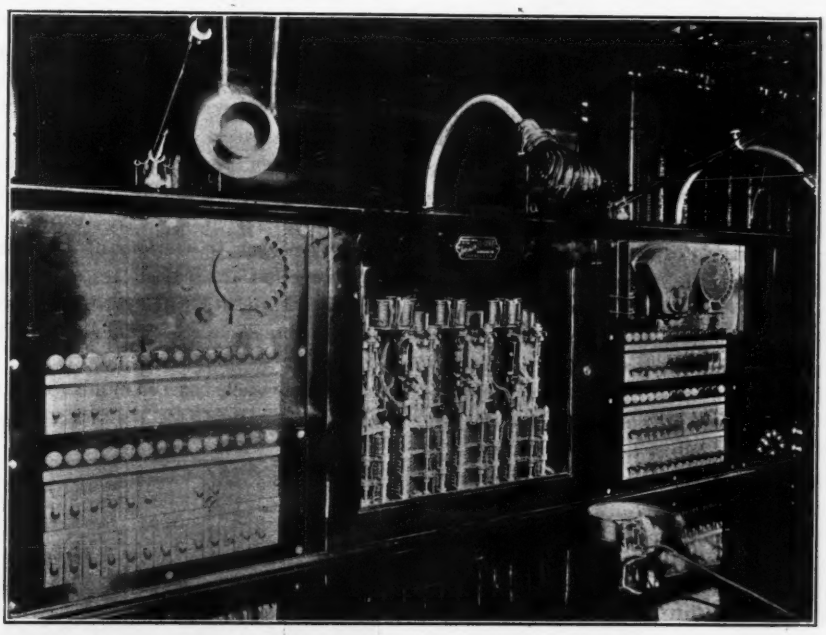


FIG. 5.—WIRE CHIEF'S DESK, SHOWING SELECTORS AND CONNECTOR WITH OTHER APPARATUS IN TESTING, AT THE LOS ANGELES EXCHANGE.

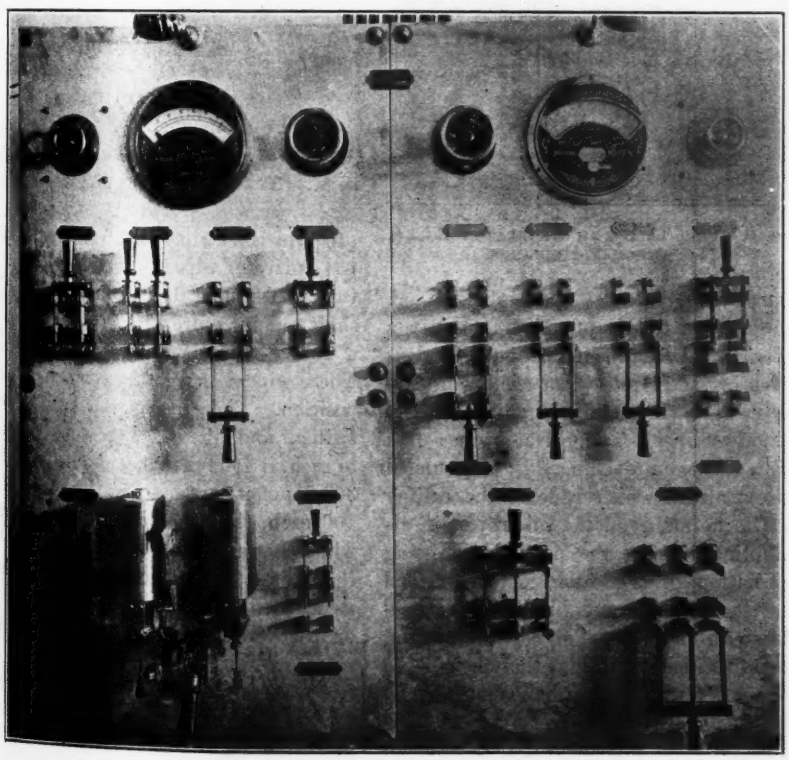


FIG. 4.—POWER BOARDS AT THE LOS ANGELES EXCHANGE.

There are three release springs provided, one for the rotary side and one for the vertical side and one for the ground. The subscriber after having sent in the number desired, by performing the above mentioned movement is now ready to ring the called subscriber, and this is done by pressing the ringing button, which automatically grounds the vertical line, opens the connection between the two lines, and at the same time, and without any further effort on the part of subscriber, pulls up the vertical relay at central office, closes the local circuit, energizes the generator relay, which in turn cuts in the ringing circuit on the called subscriber's line which rings his bell. A conversation is now established by the called subscriber taking down his receiver and talking to the party calling him. When the conversation has ceased, the act of each subscriber hanging up his telephone grounds both sides of line and returns all the conditions to normal. This movement at central will be more fully explained later.

The connecting link between the substation and central office is the customary metallic circuit used in manual practice. The tip and sleeve in that system being equivalent to the vertical and rotary in the automatic. In addition to this, ground is used at each substation, and may be either individual or common to all, according to the conditions existing.

The Strowger system is central energy signaling and local battery talking. In this regard there has been much speculation, some engineers claiming preference for one and some for the other. It is nevertheless true, that for short conversations (and these are the majority) local battery is ahead of central energy, while it must be admitted that some additional maintenance is necessary in local battery work, against this slight defect is the additional feature of not having to figure so

closely on the length of line or the proportion of cable likely to interfere with good talking. The preference for ultimate complete central energy from an economic standpoint is admitted.

In this branch exchange, in order not to conflict with the main exchange, which has a capacity of 19,000 lines, numbers commence at 20,000 (a 100,000 capacity system being used) and up; No. 22,-222 being reserved for complaint department. Opposite the digit 1 is main, so that a party in calling the main exchange pulls down the lever to main (or 1) and releases; the act of so doing works the first selector, and selects one of ten trunks not busy leading to the main office, lighting a lamp in front of the main exchange operator, who makes the connections. The subscriber in this exchange picks out his number on the dial as already explained, taking each digit separately. For example, 21569 is wanted, the dial would be pulled around to No. 2. This connects his first with the second selector. He then pulls No. 1, which connects second selector with third selector; then five, which connects third selector with the connector. The next movement, No. 6, picks out the tens, and the next, No. 9, picks out the units and connects with line. This differs from the movements in a series system, as before explained, and gives the movements as in use in the now almost universal trunking system. On the first strip of the first selector of each line there are available ten (of the 200) trunks to main, and these are so scattered or staggered as to distribute the load among the subscribers. Strip No. 2 is used for the 1,000 selector and the balance are vacant for special use.

In the Grand avenue office the power is derived from a four-kilowatt machine driven by a six-horse-power Fairbanks-Morse gas engine, delivering 53.5 amperes at seventy-five volts, and is of the Holtzer-Cabot make. Two ringing machines of seventy-five volts each furnish the power for ringing subscribers. A five-horse-power Westinghouse motor-generator is used in connection with the city power supply. All apparatus is in duplicate. At the main office a separate set is used for furnishing power for the trunks. The Ward-Leonard over and under-load circuit-breaker is used. Two sets of batteries, consisting of twenty-seven cells each, of 400 ampere-hours capacity, and delivering fifty-four volts, are used at the Grand avenue, and one set of twenty-five cells 250 ampere-hours at the main office. These are all of the American type. Lines come into the main rack, which is provided with Mr. Frank B. Cook's latest self-soldering heat coils, the same also being provided at each selector and connector, so that the apparatus is fully protected against sneak currents, a total of 10,000 being installed. A trunking position, consisting of three-point jacks, cords and plugs, is provided to care for the incoming calls between the branch and the main exchange. From the trunking position the lines run to the first selectors, which are arranged on shelves, containing twenty-five each in sections of 100 each. In this section are two shelves containing ten second selectors, ten third selectors and ten connectors, the whole comprising a board or section, there now being installed forty such boards, numbered from 0 to 40, and the division (ten

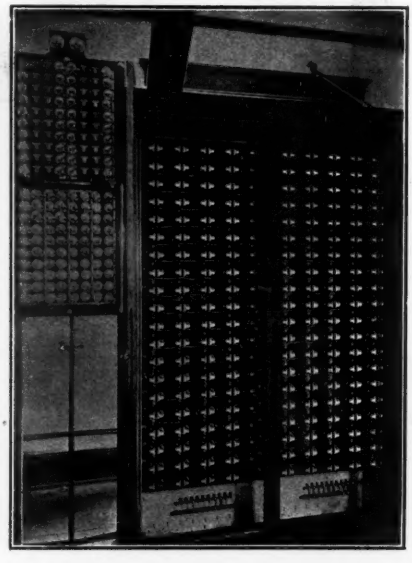


FIG. 6.—TELL-TALE AND GENERATOR BOARD, LOS ANGELES EXCHANGE.

boards each) from 21 to 24 inclusive. A special tone test is provided to notify a subscriber when a line is busy, and is given by the private wiper coming in contact with a stud, and grounding same to all other lines. The private wiper of a calling line, on touching this, is grounded as explained, which restores the calling line to normal, and the subscriber, in attempting to ring the party by pressing his button, gives the selector one vertical movement, which puts his line in connection with "busy-back" signal, the buzzing sound intimating to him that the line he wishes is busy. He then hangs up his telephone, and the act of so doing grounds both lines simultaneously and restores all selectors to normal. He must do this before attempting to make a second call. The rotary contacts of the selector are all bridged (in multiple), as are the multiple jacks in manual practice. These banks are all wired up in the factory on revolving tables, ingeniously devised and carefully and accurately planned and measured. The switches proper form a semi-circle, and the contacts are arranged around this. The contact arm, on being moved, passes over these with a wiping contact which ensures cleanliness and good contact. The arm of the vertical rod is moved from row to row by the operation of the vertical movements, and the wipers by the rotary movements. Each first selector has a bridging cutoff relay, the object of which is to cut the battery off the selector of the called party, thus rendering the line clear of all electromagnets. This relay is not in the line proper, being operated by the private wiper, which is also used, as explained, for the busy test. If a selector should (for any reason) fail to restore to normal the fact is indicated to the wire chief or attendant by a lamp lighting on the shelf containing the selector, and also on the tell-tale board. The metal of which the switches are made is non-magnetic. This is necessary to prevent interference, the whole being at times more or less in a magnetic field. The shaft is composed of two parts, the upper being specially milled for ten circular teeth, the lower having ten longitudinal teeth. A pawl forming a part of the armature is so arranged as to engage the upper teeth of the shaft. This shaft is controlled by the vertical armature, which in turn is controlled by its magnet, the whole comprising what is known as the vertical movement. At the lower end of this shaft are the three wipers, known in practice as (1) vertical wiper, (2) rotary wiper, (3) private wiper, each consisting of two blades and being fastened to the shaft so as to move with it vertically or in a rotary direction, as may be desired. These wipers engage the contacts in each position. There being 100 taps in each switch, and there being three contacts to each, it follows that the switch contains 300 contacts, arranged in three groups of 100 each, the whole constituting a bank, which is rigidly fastened to the frame of the switch. The movements of such a switch are as follows: an impulse given on the vertical side of the line grounds same, energizes the vertical magnet, attracts the armature, lifting the shaft one tooth. This movement being completed, the armature is pulled back by a spring for this special purpose, at the same time the pawl (already described) falls back one tooth, the shaft being held in all its movements by a double "dog" controlled by release relay. The shaft may, in this

manner, be held in 100 different positions, as the rotative movement is in any one of ten vertical positions. Each impulse on the vertical side lifts the shaft one tooth. The shaft may also be detained vertically in ten distinct positions. In like manner is the arrangement of the rotary armature, the pawl of which engages the lower teeth. The armature of this lies in a horizontal position in order to move the shaft in a rotary direction. In addition to the rotary and vertical magnets, there is the private magnet, which operates the side switch, and this in turn controls the movements of the rotary and vertical line contacts. The first impulse through the coils of this private magnet moves the side switch from the vertical to the rotary contact, and the second impulse to the generator relay. The side switch consists of four poles or movements, and is connected to the line relays by two main lines, the rotary and the vertical. The line relays in a series system are thirty ohms each, and are connected permanently in series with the line. A ground and a battery of fifty-four volts are common to both sides of the subscriber's line through high retardation coils. There is also provided two springs, one for each side of the line; these springs are normally clear, but on the relays being operated connect to ground. These springs are connected with the private relay, and from these to the battery, and one side is normally connected with the release relay on the vertical side. In the bridging system in use at Los Angeles, the line relays are 500 ohms each, and cut off the line by means of a 2,000-ohm cut-off relay, as before explained, and also the vertical movement of the calling subscriber.

In connection with the switches is a novel indicator of trouble in case any such should present itself, as a heat coil blowing, etc., the ringing of a bell draws the attention of the switchboard man to the fact, and at the same time a lamp lights on the "tell-tale" board. One of these lamps is provided for each 100 lines (or first selectors), thus showing in which section the trouble is; arriving at the section indicated he finds another lamp lighted showing on which shelf the trouble is. Provision is also made on the board for generator trouble, the current passing through two lamps, so that, should any line become "shorted" or "grounded," the lamp of the group in which the line is lights when the current is sent out on the line, thus notifying the attendant that trouble exists in that particular circuit. In addition to this last board, the usual wire chief's desk equipment is provided for handling the line and instrument trouble as in manual practice.

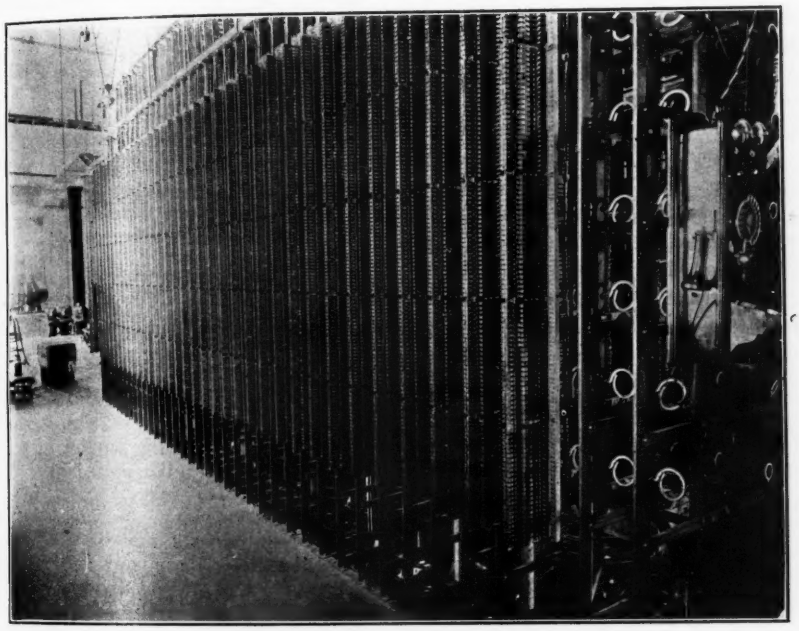


FIG. 7.—COOK DISTRIBUTING BOARD AT LOS ANGELES EXCHANGE.

An electrically driven blower running at 110 volts and consuming twelve amperes, speed 1,500, made by the National Electric Company, supplies air under pressure for cleaning the selectors, etc.

The standard Cook distributing board is used with an installed capacity of 4,875 pairs and equipped with his latest self-soldering heat coils. The board is compact, presents a neat appearance, and uses the minimum jumper wire. Mr. Cook also supplied the protective apparatus at the Los Angeles main office, having a capacity of 12,000 pairs, probably one of the largest single installations in the world. The No. 4 heat coil was formerly used, but the new one is an improvement on this, and has been adopted for future installations. The terminals are arranged in groups of twenty-five pairs, 150 pairs on the line side and 125 pairs on the switchboard side.

A multiple section of six positions is provided. This is manually operated, and takes care of all incoming calls from outside exchanges. The construction is standard, with Kellogg apparatus. To this board is connected 200 trunks from the main office and a proportionate number to the smaller offices, the whole ending in lamps in front of the operators, each trunk having a separate cord, plug and lamp, so that only one plug movement is necessary to make a connection between a manual and an automatic subscriber. Three-point jacks are used.

The trunks from the automatic subscribers are 200 in number and terminate in lamps, cords and plugs at the main or other branch exchange, as the case may be, so that only one plug movement is necessary, as in the reverse connections. Order circuits are provided for ordering up connections from manual to automatic, but the calls from the automatic to the manual are strictly automatic, being automatically selected by the subscriber, as explained.

All cables entering the building both for trunks and lines are 300-pair, and pass underground directly to the rack where the paper-insulated cables are spliced to silk and cotton-insulated cables by a hermetically sealed splice, the other end being formed to fit the rack, taped and shellaced thoroughly to prevent absorption of moisture.

The formal opening of the exchange took place in the form of cutting over 150 subscribers on July 27, 1904, the whole passing off very smoothly. The balance will be cut over at the rate of 150 per day until all the subscribers now in the old exchange are transferred to the new, about 2,000 in all. In addition, 2,000 new lines are being cut in at the same time, and it is hoped that the exchange will be in full operation by September 1. To the average reader the labor, expense and time necessary to install an exchange of this kind can hardly be appreciated, not knowing its complexities. That the Automatic Electric succeeded in installing the exchange in so short a time is considered wonderful, in that it has a complete new departure from all past efforts in this direction.

In the preparation of the plans no expense was spared to make this a model exchange, it being understood that if it proved successful its adoption for all exchanges of this company on the Coast would be only a matter of time. The exchange, as it stands to-day, is probably without a peer in the world, and is unique in many respects. All the material is of the best, and this system was only adopted as against all manual systems after careful deliberation and consideration on the part of the officers and engineers of the Home Telephone company.

## ELECTRICAL MINING NOTES.

SIDNEY F. WALKER.

### ELECTRIC DRIVING IN SOUTH WALES COLLIERIES.

The most important development at present in connection with electricity and mining is that which is in progress in South Wales, where the South Wales Power Distribution Company is arranging to drive several of the collieries entirely by electricity delivered from its generating stations. The collieries in South Wales lend themselves particularly to this. The area of the paying coal field is small, and the collieries are all distributed along a number of valleys, two or three of which usually run out at one point. At Pontypridd, for instance, in the Taff valley, receives the Rhondda valley, and a little way up the Rhondda valley, the Little Rhondda valley, or Rhondda Fach, as it is called, opens. A little way up the Taff valley, above Pontypridd, another valley, that of the Cynon opens, running up to Aberdare and all along all of these valleys there are large collieries about every mile or so, turning out usually, at least, 1,000 tons of coal a day, the valleys extending about sixteen miles up from Pontypridd. Similarly in Monmouthshire a set of valleys open from Pontypool, and another from Aberbeeg and there are collieries all along these. And again there are valleys away to the west, opening at Tondu, a few miles above Brigend, and others further to the west again. The South Wales Power Company has opened stations at the Forest, a little below Pontypridd, in the Taff valley, a little below Pontypool and in the neighborhood of Bridgend. Current is being generated on the three-phase system with a periodicity of twenty-five, in units of 3,000 horse-power each, and is being transformed up to 11,000 volts, for distribution, the standard pressure at the collieries being 440 volts, transformers being fixed in the neighborhood of each colliery taking current. One large colliery in the Rhondda Fach valley, the National, is stated to be taking 800 horse-power for hauling, winding and pumping and all the collieries in that valley are stated to be going to follow suit. The Pontypridd generating station has forty miles of distributing mains laid up the valleys opening out at Pontypridd; they are supplying over 4,000 horse-power already and have nearly 3,000 horse-power more to supply. In Monmouthshire the station near Pontypool is supplying over 1,300 horse-power, and is stated to have an additional 1,000 horse-power to supply. At Bridgend not much has yet been done in supplying the collieries, the town of Bridgend itself taking the bulk of the current generated. The price at which current is being supplied is three-quarters penny per Board of Trade unit. This is a considerable reduction upon the prices originally proposed, and in my opinion it is still open to considerable doubt whether the collieries are making a good thing out of it. My view always has been that, while small concerns would find it a very good arrangement, and a very economical one, to take power from a central supply station just as small consumers of gas, small manufacturers, find it advantageous to use gas engines and to take their supply of gas from the town gas works, immediately their requirements become greater than a certain figure, it is more economical for them to put down either their own boiler plant or their own gas plant and so in my opinion it should be cheaper for all the large collieries to put down their own electric installations than to take current from the supply company. As is well known, there is always a limiting quality above which no economy is realized when the production exceeds that figure. There is a limit to the quantity that every machine will turn out and to the current that every station will turn out; up to that limit every additional unit sold reduces the cost of all the units, but after that is passed the decrease in cost ceases to operate. In my opinion this is the case with collieries. The quantity of power they require is above that which makes the limit of economical production and so they should be able to produce as cheaply as the power station, while they have a very much smaller area to distribute over. Their standing losses should be less than those of the power station. One very large colliery company, the Powell Duffryn Company, which has collieries in the neighborhood of Aberdare and in Monmouthshire, is laying out a generating station near Aberdare to supply the collieries on that side; it will generate 6,500 horse-power and they will distribute current over an area whose radius will be about three miles, if the station is placed in about the centre. In my opinion they should come out better than those who take current from the power company. There is every opening for power supply in the South Wales collieries, and the ironworks which are often connected with them, and for very considerable economies in connection with the electrical distribution. In several instances the works of one large company extend right down the whole of one valley, for six or seven miles, and there are boilers and engines at every one of the works, though in many cases two works will be only a few hundred yards apart. But carrying steam even a few hundred yards is expensive work. Obviously all of these might be run from one electric generating station, but the company should generate cheaper themselves than can be done for them. The figure also, three-quarters penny per unit, has been very much bettered; at collieries which are generating their current on not a very large scale 0.375 penny is quite common. I have had several cases through my hands, in my practice, where the question has arisen whether it would be cheaper to generate current on the works or take it from the local power company. In every case so far I have advised, on the figures before me, allowing for all charges, including interest and depreciation, that the cheapest course was to generate their own.

There is another striking case in India, the government of Mysore has laid a very extensive system of electricity supply from the power of the Cauvery Falls. The power is taken by the gold mines in that district, but immediately they have proved that electric driving is practical, they are putting down their own plant. Companies interested in the Mysore gold mines have formed a company solely for the purpose of generating current for the gold mines. The companies have taken shares in the electricity company in proportion to their requirements and it is ordained that the electric company is not to pay more than ten per cent dividend. On the other hand in South Africa some of the mines are taking current from the supply company whose works are just outside Johannesburg, in one case the supply pressure being 10,000 volts, transformed down at the mine.

### The Discovery of Pitchblende Ore.

It is reported that a large vein carrying yellow oxide of uranium and black pitchblende has been discovered in the south slope of Rhyolite hill, in Cripple Creek district, in the property of the Rhyolite-Beacon Mining Company. The vein is two feet wide in a shaft thirty-five feet deep, and appears to be continuous. Samples of the ore are at present in the hands of assayers. With only one and a half ounces of the crude ore, separated from the plate by twenty-four sheets of black paper, very good photographs have been made on a forty-eight-hour exposure. It is reported that this ore has been found in three different places.

## UNACCOUNTED-FOR CURRENT.[1]

BY W. E. RICHARDS.

For the purpose of discussion in this paper, the term of "unaccounted-for current" is taken to mean that part of the current output of the power station which is not accounted for in the charges or income.

The lost or unaccounted-for current incident to the operation of an electric light and power plant is governed in a measure by the local conditions, and is a feature too often totally or partially lost sight of by many station managers. This condition is rapidly changing for the better, compared with the operation of electric plants not many years ago, when the average station manager and his electrician knew comparatively nothing of their losses. Now we are stimulated by competition and interest in the work, to locate and reduce many of the losses that existed.

Care and thought should govern the selection and design of the equipment, and first cost should not be the only consideration. Starting even with the best equipment obtainable, losses will exist and creep in in a degree proportional to the efficiency of the management. To reduce these losses to a minimum, the different appliances through which the current passes from the generator to the consumer were taken up, any one of which is a study in itself. The investment in conductors from the generators to the switchboard is not usually great and is easily designed. Therefore the loss is invariably small, but real trouble commences with the station instruments. Their function is not simply to point to something or rotate, but they should be in a condition to record accurately the station output. One is very often satisfied to assume that his station instruments are right, probably because it is quite difficult to make the necessary tests to verify their accuracy. Upon checking, seldom are they found to be exact. A systematic cleaning and checking of our station instruments every thirty days gives results that show that it was needed. Of course there is no current loss at this point, but upon these instruments depends, to a certain extent, the indication of losses.

While there are some losses due to bad insulation on the distributing system, the greater loss occurs from improper design. Design for line loss can not be followed by the usual formula entirely, as local conditions must be considered as well. Current losses will be considerable by reason of accidents, partly due to improper maintenance, and to reduce this the lines must be kept in good repair. A systematic overhauling is necessary at least once every three years. Care and judgment should be exercised when installing transformers, as the copper loss of the distributing system, if properly designed, will be slight, compared with total losses of individual transformers.

The final leak in a system, and the most important of all, occurs in the meter department. There losses may be divided into two parts: first, energy loss in the meter circuits; second, loss due to slow meters failing to record the full amount of the energy passing through them.

The loss in the meter pressure circuit, in the most common type of direct-current wattmeters, may be from 35 to 125 kilowatt-hours per year. In the induction type of meter the list varies from seventeen to thirty-five kilowatt-hours per year. The loss of energy due to drop in the series field can be neglected, especially when the meters are tested by the common method, as, owing to the connections of the meter and instruments, the former is calibrated to record this loss. Where the meter is tested by disconnecting the potential circuit from the series field, and the series field loaded by a storage battery, this loss then falls on the company, but as this loss depends on the load it can be neglected, since in a good type of the commutator meter it will be one-quarter to one-half of one per cent, depending on the capacity of the meter. On sizes larger than two hundred lights, this loss will only be one-quarter of one per cent. In some types of small size meters we have found a loss as high as one per cent on full load, but this is exceptional.

Assuming the meter to run correctly when it is installed, the losses due to meter becoming slow depend on the type of meter, the load on which it operates and the attention given the meter.

The following data, taken from actual practice, show how important the lost or unaccounted-for current may be in the commutator type meters on residence lighting. The figures give the percentage of the true energy recorded by the meter:

| | LOAD. | | | | |
|---|---|---|---|---|---|
| Length of Service. | 1/20 | 1/10 | 1/4 | 1/2 | Full. |
| Months. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| 5 | 77 | 88.7 | 95.0 | 98.5 | 99.5 |
| 8 | 70 | 83.5 | 92.8 | 97.7 | 98.5 |
| 12 | 69 | 83.5 | 92.8 | 97.7 | 98.5 |
| 21 | 63 | 82.0 | 92.0 | 96.5 | 97.8 |

To a considerable extent the accuracy of the meter on light loads depends on the condition of the jewel, and as the life of the jewel depends on the number of turns, this and other causes make individual meters differ widely from the above values.

The author's practice is to install meters of a capacity as near the burning load as possible, but, even with this precaution, the data show a loss of twelve to eighteen per cent on one-tenth load, and five to eight per cent on one-quarter load. Between these two points, may be taken, a greater part of the business will lie.

Where there is considerable consumption recorded in large stores at one-quarter load or less, an effort should be made to meter this service separately.

These losses in unaccounted-for current can be reduced to a minimum only by an intelligent effort of the meter department, since upon the care and upkeep of the meters depend at least ten per cent of the earnings of the company. It is practical to clean and inspect the meters systematically, the interval of such cleaning and inspection depending on the capacity and service. If the meters are of the induction type, the author's practice is to give them attention every eighteen months, but the commutator type requires an inspection every eight to twelve months. It pays to keep constant check on large consumers, as often as every 90 to 120 days. This frequent inspection has good effect, not only on the reduction of meter losses, but on current loss from theft, which is also quite an item.

[1] Abstract of paper read at the convention of the Ohio Electric Light Association, August 16.

## *A New Method of Measuring the Intensity of the β-Rays Given off by Radioactive Bodies.*

Mr. W. Seitz describes a method in the *Physikalische Zeitschrift* for measuring the intensity of the $\beta$-rays given off by radioactive bodies. In this the converse principle to that adopted by Stutt and by Paschen is used. Instead of measuring the positive charge which accumulates on the radioactive body in a vacuum, the magnitude of the negative charge produced by the impact of the rays themselves on an insulated metallic disc suspended in an exhausted glass vessel is determined. The study of the steady absorption of the rays caused by the interposition of thin sheets of various metals is aided by the apparatus used. It is shown that the law of Lenard, to govern the absorption of the cathode rays, roughly applies also to the $\beta$-radiation—that is, per unit of surface the same absorption is caused by equal "masses" of the different materials, these masses being measured by the product of thickness and density. The law, however, is only approximately true, and in the case of the elements there is an increase in the absorption for equal masses per unit of air with an increase in the atomic weight.

## LETTER TO THE EDITOR.

### Battle of the Powers.

To the Editor of the Electrical Review:

We have just read the very interesting editorial in your Saturday's issue on the above subject. In this connection, you may be interested in the report of a series of pumping engine tests enclosed herewith.

The engines described are of the triple-expansion type using superheated steam, but not provided with flywheels. Nevertheless, all showed economies per indicated horse-power of less than eleven pounds of steam, one showing as low as ten and another 10.01 pounds, and the steam consumption per horse-power delivered in water raised was only 11.32 pounds in the best case. These are slow-speed engines of about 600-horse-power capacity.

Your readers may be interested in these facts, which indicate the, as yet, unexhausted possibilities of the reciprocating steam cylinder.

International Steam Pump Co.

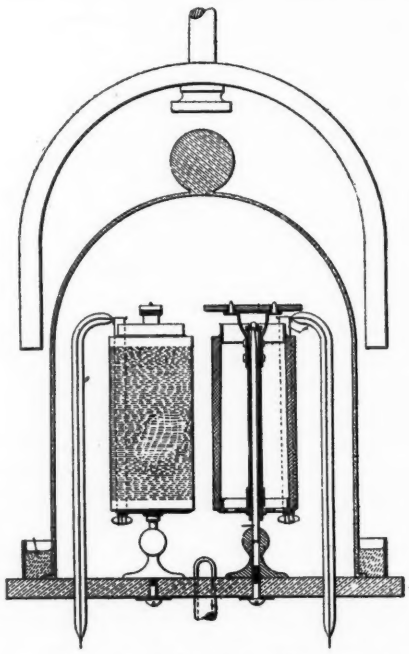
New York, August 8.

[The tests referred to by Mr. Gibson were made on the equipment of two of Chicago's new pumping stations. Six engines were tested, the indicated horse-power varying for the different units from 600 to 675 horse-power. The number of degrees of superheat at the throttle was, at one station, about seventy-five, and at the other about 130 Fahrenheit. The vacuum was approximately twenty-seven inches, and the steam pressure 145 pounds. The duration of the trial in each case was twenty-four hours. The duty per 100 pounds of coal used, expressed in foot-pounds, varied from 130,000,000 to 151,000,000. From the calorific value and the duty tests, it is seen that the energy efficiency from coal to water moved was a little over thirteen and one-half per cent.

It is our custom to expect high efficiency of pumping engines, possibly because of the great amount of engineering skill which has been expended in developing them, and partly because they usually operate under favorable conditions of load. The character of the load, however, opposing, as it does, a constant force to the movement of the plunger, makes some balancing device desirable. The latter must lower somewhat the efficiency of the engine, though this effect may be exceedingly small. It is, nevertheless, a disadvantage under which pumping engines labor. These tests and others on other engines indicate that the reciprocating engine is not entirely out of the running, and it may be expected that it will contest the field sharply against both the steam turbine and the gas engine—at least for some time to come.—Ed.]

## Electrical Patents.

One of Mr. Thomas A. Edison's latest inventions is an apparatus for vacuously depositing metals; he has assigned the patent obtained thereon to the New Jersey Patent Company, of Orange, N. J. The apparatus has been designed particularly for depositing on phonograph records a minutely thin film of vaporized metal which shall act as a foundation for the heavier electroplated deposit in order that a matrix mould of such a record may be secured. The instrument used is constructed as follows: a base is provided with supports on which are



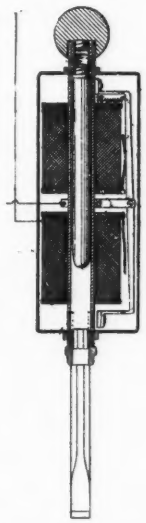
Apparatus for Vacuously Depositing Metals.

mounted base-plates, preferably made of glass. Extending up through the base-plate are glass tubes carrying circuit wires. Depending from the ends of these conductors are electrodes made of the metal which is to be deposited, preferably in the form of thin strips of foil. Mounted on the plate is a metal rim within which is placed a glass bell or jar having a flanged lower end resting on the plate. A layer of paraffin in molten condition is flowed into the space within the rim, so as to make a perfectly tight joint. Air from within the glass bell is exhausted through a pipe connected with a vacuum pump of any suitable and approved type. Within the vacuum chamber are one or more supports which carry vertical shafts having tapered upper ends. Surrounding each of these shafts is a sleeve provided with a hardened bearing-cup at its top which engages the shaft. The lower end of the sleeve carries a disc which receives the record or other object. Extending up from the sleeve are arms which receive a removable armature. The phonograph record or other object carries at its top a guard or shield which fits within the top of the record and is supported thereby. This guard is preferably made of brass. The guard receives the metal which would ordinarily be deposited within the interior of the record; when made of brass it appears to deflect the electrical discharge in a downward direction against or toward the outer surface of the record. The guard thus prevents the metal from depositing on the inside of the object and causes it to deposit evenly on the edge with a clear line of demarcation, so as to permit a uniform electroplating. Mounted outside of each of the vacuum chambers is a magnet, removably carried at the lower end of the shaft, mounted in the bearing and rotated by a belt-wheel to which power is applied. In order to operate the vacuum chambers alternately to permit the electrodes within one to cool while the depositing is taking place in the other, a switch is employed, preferably driven by a clockwork mechanism and making contact alternately with contact-springs. These springs are connected each with one of the electrodes of the two chambers. The other electrodes are connected to one side of the secondary circuit or an ordinary induction coil. The other side of this secondary circuit connects with the switch through the clockwork mechanism. The primary circuit of the induction coil is connected in multiple with a source of supply and includes a circuit-breaker. In operation, a proper vacuum is created in the two chambers and by means of the switch the induction coil is connected alternately; first, with the electrodes of one chamber and then with those of the other. The regulation is such as to secure a silent or brush discharge between the electrodes. This discharge causes the metal composing the electrodes to be vaporized and deposited on the objects. The magnets are simultaneously rotated, so as to rotate the objects, whereby a perfectly uniform film is deposited thereon. When this film is of the desired thickness, the bell or jars are removed, permitting the coated objects to be removed for subsequent treatment.

Mr. Edison has recently patented an improvement for primary batteries, which relates to the manufacture of copper-oxide electrodes for primary batteries, pref-

erably of the Lalande type, wherein copper oxide is opposed to metallic zinc in an alkaline solution. The patent has been assigned to Edison Manufacturing Company, of Orange, N. J. The object of the invention is to produce a copper-oxide electrode of superior quality and at a moderate cost. In the use of batteries of the Lalande type on discharge the copper oxide is reduced to the metallic state and the zinc oxidized. The cell does not reach its normal discharge rate until the surface of the negative electrode is completely reduced to the metallic state, so that it is the practice in the art to preliminarily reduce the surface of these electrodes before assembling them, so as to save the time required to effect this reduction in the cell itself. Mr. Edison has found that very good results are obtained by dispensing with the preliminary reduction of the copper oxide and substituting therefor a treatment with ordinary red oxide of copper applied in any suitable way, as, for example, by rubbing the red oxide on the surface of the electrode. The electrode is more or less porous so that the particles of red oxide adhere very tenaciously to the surface. A copper-oxide electrode so treated when properly connected up in a cell gives a very satisfactory discharge rate, and since the oxide is readily reducible, the surface reduction to the metallic state progresses rapidly, so that the cell quickly reaches its full discharge rate. The copper-oxide electrodes which are thus treated can be obtained in any way, but it is preferable to make them by treating precipitated hydroxide of copper with hypochlorite of sodium, thereby providing an excessively finely divided black oxide of copper which is then dried, moistened with a solution of sodium, and pressed into plates of the desired form, and burned in the regular manner to consolidate the mass.

An electric hammer has recently been patented by Joseph Chambers and Corydon L. Cole, of Minneapolis, Minn. Mr. Cole has assigned his interest in this patent to George J. Backus, of the same place. In carrying out the invention a pair of electromagnetic coils are employed, contained on insulating spools, axially aligned and rigidly secured to a bearing sleeve of brass. A knob, in the form of a ball, is screwed on to the rear end of the sleeve and within this sleeve is placed a buffer with its base of reaction against the knob or hand-piece. A tool-receiving socket mounted for limited axial movements in the front end of the sleeve is provided with a seat adapted to receive the shank of a chisel or tool of other form. This socket is provided with a reduced sleeve portion which telescopes into the sleeve and also with a plurality of parallel circumferentially disposed guide fingers that surround the end of the sleeve and work loosely through notches formed in the forward end hub of a metallic case rigidly secured to the sleeve and enclosing the magnets. The case is open at its lower portion and is provided with a detachable supplemental section held thereto by tongue-and-groove joints. A reciprocating plunger works loosely within the sleeve and operates as a hammer when reciprocated by the magnets. Rigidly secured to the sleeve between the magnets is a fulcrum bracket to which is pivoted the intermediate portion of a switch lever. This switch lever is constructed of some non-magnetic material which is



ELECTRIC HAMMER.

an electric conductor and at its free ends is provided with iron and steel armatures, which lie close to the ends of the sleeve, but engage this sleeve one at a time. It is not necessary that the armatures engage the sleeve, but the sleeve serves as a convenient stop for limiting the movement of the switch lever. A pair of spring-contacts are provided for cooperation with the portions of the switch lever, the same being conveniently supported at one end, one from each of the magnet spools. These contacts engage with the switch lever one at a time, and are connected by short wires to the magnets that lie on the opposite sides of the fulcrum of the switch lever. A source of electrical energy is provided having leads, one of which is electrically connected to the metallic fulcrum bracket, while the other is connected by branch leads to the terminals of both the solenoids or magnets. To ensure the engagement of one of the contacts with the switch lever when the actuating circuit is broken, one end of the switch lever is connected by a light spring to the right-hand solenoid spool. A push-button circuit-maker and breaker is interposed in one of the leads. The hammering plunger at the forward end of its reciprocatory movement strikes against the shank of the tool and at the other limit of its movement strikes the buffer-spring. When the right-hand solenoid or magnet is energized and the left-hand solenoid or magnet is deenergized, the plunger, acting as the needle of the solenoid, will be thrown to the right against the buffer-spring and will be held there as long as the right-hand solenoid is energized. When the left-hand solenoid is energized, and the right-hand solenoid is deenergized, the plunger will be drawn toward the left with a sudden impulse and will be caused to deliver a blow to the tool.

## *Rules for Electric Motors.*

The rules for installing electric motors in textile and flour mills and other places where they are exposed to dust have been revised by the Associated Fire Offices, England. These rules require that motors, when not in an engine room or in a separate compartment expressly set apart for their use and built of or lined with incombustible material, must be completely enclosed in a metal case. Ventilation in the vertical portion of the metal case must be protected by two thicknesses of wire gauze. Induction motors may have unprotected ventilation openings in their metal cases, the superficial area of each opening not exceeding one-quarter of an inch, and the openings being at least one-quarter of an inch apart. Slip rings, brushes and any other sliding contacts must be enclosed in metal cases. Inspection openings, fitted with plate-glass, are allowed. No unprotected woodwork or combustible material must be within eighteen inches of any motor, and wood floor beneath any motor must be protected by a sheet of metal. The motor pulley must be external to the metal case enclosing the motor. Only the shaft and the connecting conductors may be carried into the metal case or through the walls of the compartment. No ropes, belts or other gearing may be so carried. In installing dynamos the same rules apply. Resistances in starting transformers must be similarly situated, and must be enclosed, as required for motors. All metal cases and tubes must be connected to the ground, and motors must not be supplied with current from dynamos or conductors having an earth return.

# Reviews of Current Engineering and Scientific Literature.

### *Advantages of the Three-Cylinder Compound Gas Engine for Large Powers.*

The advantages of gas engines constructed with three cylinders, two of which are explosion cylinders, and the third an expansion cylinder, are here dwelt upon by Mr. Edward Butler. He believes that, from the point of view of correct balance of the moving parts, combined with the regular turning action, the compound three-cylinder, three-crank engine is the most perfect yet considered. With this engine, when single or double-acting cylinders are used, there is an even balance obtained from the reciprocating action of the three pistons. The two explosion pistons are connected by two cranks at the same angle, being balanced by the expansion piston connected to the central crank at an opposite angle to this. The weight of this piston and rod is practically equal to the combined weights of two smaller pistons and rods. This engine gives four equally spaced impulses during each cycle of two revolutions. Its torque efficiency is very high, being higher than that of any other gas engine, if it be made double-acting. From the point of view of economy the compound engine scores the best advantage. The expansion cylinder may be made large enough to expand the gases down below atmospheric pressure. By this means a flushing current of cold air is induced to flow through the explosion chambers at the termination of each exhaust stroke. This action secures higher power duty from the engine when using diluted carbon monoxide gas, but is not of particular advantage for small engines using town gas, except that it enables the engine to continue at full load without overheating of the surfaces in contact with the gases of combustion. When the engines are over thirty brake-horse-power compounding is an advantage and an economy. For large powers, double-acting engines designed for a continuous working load of 5,000 horse-power on producer gas seem adapted for central stations where economy of fuel is a first consideration. A double-acting expansion steam engine of this type occupies less space than a triple-expansion steam engine of the same power, and gives a possible fuel economy of thirty per cent. An engine of this type gives eight equally distributed impulses during each cycle of two revolutions, and, owing to the excellent balancing, requires but light foundations. It is thought that this engine combines more advantages from the point of view of large power units than any other type of gas engine.—*Abstracted from the Electrical Magazine (London), July.*

### *Investigation of the Commutation of a Direct-Current Dynamo.*

In this study M. A. D. Iliovigi describes at length the methods which he has been using for investigating the commutation of continuous-current dynamos, and gives some of his preliminary results. As measurements were to be taken at points separated from each other by small distances, every precaution was taken to avoid vibration. Since readings of slight differences in potential were to be obtained, none of the automatic recorders could be employed. Recourse was then had to a galvanometer through which a condenser was discharged by means of a Franke indicator. This indicator is a collector consisting of five metallic segments, four of approximately sixty degrees, and one 120 degrees wide, separated by insulating material. On the collector two small brushes press, spaced a little less than the width of the longest segment. These brushes are connected in the circuit with a condenser, and the source of electromotive force to be measured. The condenser is shunted by a resistance and a galvanometer. It is charged during the time that the two brushes are upon the longer segment, and is discharged through the shunt circuit when the first brush leaves the segment. The charge of the condenser is proportional to the electromotive force at the instant the circuit is broken. There is a slight error due to the current passing through the shunt circuit while the condenser is being charged, but it is shown analytically that this error can be made negligible by a proper proportioning of the condenser and the shunt circuit and proper spacing of the brushes. The preliminary experiments consist in determinations of the variation of intensity of the current in a section short-circuited by a brush. Three methods were used. In one the lead from the commutator to the coil is opened by means of two collector rings and brushes, and non-inductive resistance is inserted. The current flowing at any instant is proportional to the fall of potential along this resistance. In the second method a non-inductive resistance is inserted in the same way, but in the coil at the end of the armature opposite the commutator. In the third method a fine wire is laid side by side with the coil to be studied. One end of this is connected to the coil, and the other end is brought out by means of a slip ring, and a tap is also taken from the adjacent end of the armature coil. On the supposition that the electromotive force induced in this exploring coil is just equal to that induced in the main armature coil, and since the two are connected together, the difference in potential existing between the taps is, at any instant, proportional to the fall of potential in the armature coil, due to ohmic resistance. Experiments were also made to determine the variation in the electromotive force induced in a section of the armature short-circuited by a brush during the duration of short-circuit. It was found from this that the effect of the electromotive force of self-induction is not negligible in comparison with the armature reaction. An investigation of the fall of potential between a brush and a commutator segment, while the latter is under the brush, shows that the same fall of potential exists at all points of the brush surface at any instant, but it varies for different segments. Curves are given to show the variation in the fall of potential between a brush and a segment during the passage of the segment under the brush. In one investigation the output of the machine was varied, the brush position being fixed. In another, the output was fixed, the position of the brush being varied.—*Translated and abstracted from La Bulletin de la Société Internationale des Électriciens (Paris), July.*

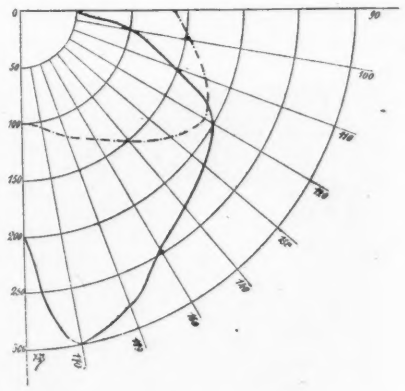
### *The Location of Lightning Arresters.*

In an article by "J. W.," the value of kicking coils as a protection against lightning is discussed. The usual location of lightning arresters in a traction generating station is on the back of the feeder panels. Just why they are placed there is not apparent, as it is neither an ideal place nor is it always convenient. In connection with the arrester, it is customary to introduce a kicking coil, which is credited with considerable powers of hold-

ing back the lightning discharge and forcing it to break across the air-gap of the arrester. This coil is commonly made up in two forms—the one a cylindrical spiral, the other discoidal. The former is employed chiefly in direct-current work and the latter on alternating-current systems, this shape being the more efficient. The kicking properties of the coil depend upon the self-induction thereof, and the maximum value possible for this inductance is given by the formulæ $L = 6 s \times \lambda$, where $s$ is the number of turns and $l$ the mean length per turn in centimetres. If the coil is arranged in a discoidal spiral, the maximum value of the self-induction lies somewhere between $6 s \frac{3}{4} \times \lambda$ power and $6 s \frac{3}{2} \times \lambda$. Standard kicking coils have usually about sixteen turns, with a mean diameter varying from two and a half to three inches, and they contain from 126 to 150 inches of conductor. If these coils be wound in a large close rim, the inductance will be given by $L = 6 s l$. When the coil is an open discoidal spiral, the inductance will be equal to $6 s \frac{2}{3} l$, and when the coil is an open helix the inductance will be equal to $6 s \frac{1}{2} l$. The best arrangement will give an inductance sixteen times that of a straight wire. In the second case the inductance is increased six times, while the third case gives a gain of only four times. From this it follows that if the arrester is connected to the feeder, say, forty or fifty feet away from the switchboard, the intervening length of conductor will have all or more than the effect of the kicking coil. On lead-covered, metal-sheathed arresters there is little need for a lightning arrester at all at the station end. One should be located at the far end to protect the cable, and if one is added to any station to serve as a discharge-gap for possible surges of potential, there is no necessity for using the kicking coil. The arrester should be placed close to the feeder, and as close as possible to the ground. The connection to it must be short and of ample section. It is advisable to have a suitable discharge-gap on any circuit that is likely to be subjected to abnormal static charges or effects. This arrester should be placed where it is most effective. There is no reason why it should always be placed at the back of the switchboard.—*Abstracted from the Electrical Review (London).*

### *The Bonhivers Diffuser.*

The Bonhivers diffuser for arc lamps, described here by M. De Kermond, consists of a disc of refractory earth of special composition, pierced centrally by an opening just large enough to allow the extremity of the upper carbon to pass through. This disc becomes incandescent, due to the high temperature to which it is carried, and it further acts as a reflector for the luminous rays emitted by the arc. It makes the lamp steadier, diminishes the consumption of carbon, and increases the luminous intensity of the lamp. The light given by a lamp equipped with this diffuser is very similar to daylight, since the red and violet rays of the ordinary arc are suppressed. This fact makes it permissible to do away with opalescent or ground-glass globes. The diffuser is formed of a porous body of very refractory material which has been baked at a very high temperature, and which is impregnated with the oxides of metallic earths by means of baths and successive bakings. This results in a diffuser which is very resistant at high temperature, and which has a useful life of over 2,000 hours. The shape of the diffuser may be varied from flat, concave or convex, according to the distribution of light desired. In size it varies from six and one-half to twelve and one-half centimetres, and has a thickness of from eight to ten millimetres. It is held by a metallic ring, and the sizes of the two carbons are so selected as to keep the position of the arc fixed relatively to the diffuser. The diffuser may be used both with alternating and direct-current lamps, but when used with the latter, the positive carbon must be placed at the bottom. The accompanying diagram is a graphic representation of the results obtained at the Laboratoire Central, Paris, the solid line representing the distribution with the diffuser, and the broken line the diffusion of the same lamp without the diffuser.—*Translated and abstracted from L'Electricien (Paris), July 30.*



DISTRIBUTION OF LIGHT WITH BONHIVERS DIFFUSER.

### *The Traction of Carriages.*

In this communication Mr. Cecil G. Saunders explains the effect of the length of a vehicle upon its draught. The draught of a vehicle depends largely upon the ratio that exists between the distance from wheel to wheel and the height of the centre of gravity from the ground. If the wheels are far apart, and the centre of gravity low, the carriage is hard to draw. If the wheels are closer, or the load higher, the draught is lighter. The reason for this lies in the fact that when a wheel passes over an obstruction the centre of gravity must be raised, and, at the same time, tilted back. If the load is low, and the wheel-base long, the motion of the centre of gravity is practically all vertical, the horizontal movement being slight. If, on the other hand, the load is high and the wheel-base short, the principal motion of the centre of gravity when the wheel passes over an obstruction is horizontal, there being but little lift. This is, of course, effected by the springs. Heavy draught depends upon, or is caused by, having to lift the centre of gravity rapidly. It may be lightened by easy springs, large wheels, putting the load high, or putting the wheels near together. —*Abstracted from Nature (London), August 4.*

## *The Colorado Electric Light, Power and Railway Association.*

The probable dates for the next annual meeting of the Colorado Electric Light, Power and Railway Association, at Colorado Springs, Col., are September 21-23. It is the purpose of the directors to invite not only the members of the central station companies of Colorado, but members of companies in the surrounding territory. This association is planning an interesting series of sessions for the winter.

## *Against Government Control of Wireless Telegraph.*

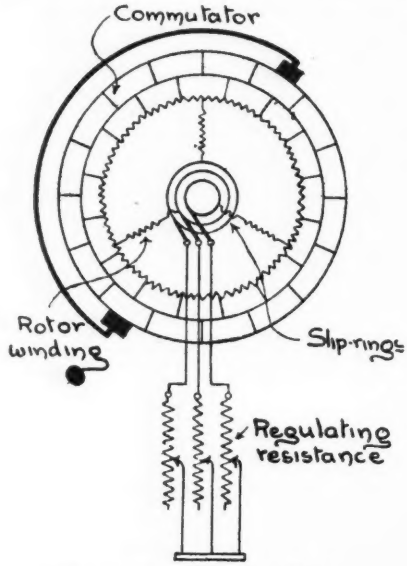
Secretary of War Taft does not approve of the plan to have the navy department control the wireless telegraph stations in the United States. He says: "It seems to me that it would be sufficient for the joint navy and army board in time of peace to keep a record of all stations, both public and private, with power in the navy department to assume control of them in time of war. Provision as to control of private stations will probably need legislative action."

# INDUSTRIAL SECTION.

*ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.*

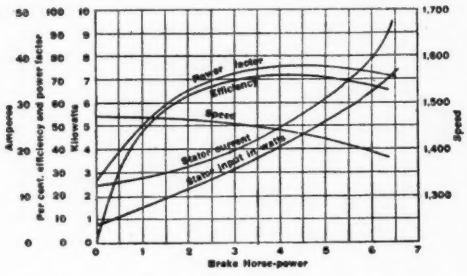
## *A New Single-Phase Motor.*

A new single-phase motor is being brought out by Messrs. Witting, Eborall & Company, of London, manufactured under the patents of Mr. V. A. Fynn. In these motors the rotor has two interconnected windings, the ends of one being connected to slip rings, and the ends of the coils of the other to a commutator. The accompanying diagram shows the winding of a four-pole motor of this type.




WINDING OF A FOUR-POLE MOTOR.

In the larger sizes of motors the brushes on the commutator are connected through a variable resistance, which is gradually cut out as the motor starts. In smaller motors the brushes are permanently short-circuited. No adjustment of the brushes during running is necessary. The slip rings are connected to a resistance in a manner similar to the starter of a three-phase induction motor. The motor starts as a repulsion motor, and, by means of the regulating resistance connected to the slip rings, the speed may be regulated at will. At full speed the motor operates synchronously. The accompanying curves show the performance of the 250-volt, fifty-cycle, five-brake-horse-power motor of this type. It is said that the starting current with full-load torque does not exceed three-fourths of the full-load current, and when starting with a torque twice that of full load, the starting current is only one and one-half times the full-load current. These motors are thought to be particularly suitable for elevators and hoists, but are well adapted for all classes of work.




PERFORMANCE CURVES OF SINGLE-PHASE MOTOR.

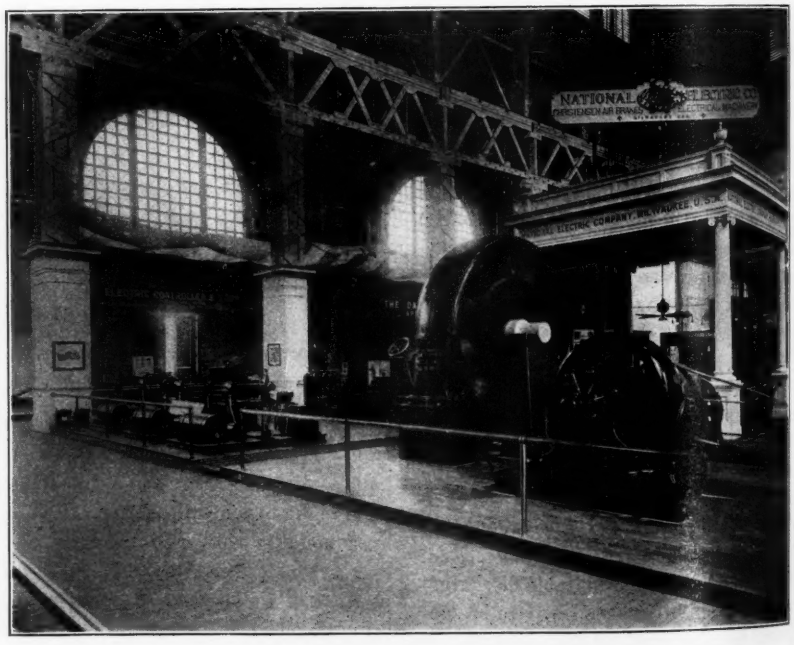
## *Exhibit of the National Electric Company.*

The National Electric Company, successor to the Christensen Engineering Company, Milwaukee, Wis., has an extensive exhibit at the Louisiana Purchase Exposition, showing to advantage its well-known Christensen air-brake equipments and electrical machinery. Its space at section six, Electricity Building, is handsomely finished, and inviting to visitors. A large 400-kilowatt, direct-current, engine-type generator is the largest unit shown at this space; a 150-kilowatt, 500-volt, direct-current generator is driven by a twenty-horse-power, 220-volt motor, and in addition to these there is in operation a 150-kilowatt, 3,200-volt alternator, a ten-kilowatt motor-generator set, and a sixty-kilowatt, 500-volt, direct-current generator belted to a thirty-horse-power, 220-volt motor.

A three-car train, showing the operation of its air-brake control, such as is used by the South Side Elevated Railway, Chicago, the Boston Elevated, and the Intramural railways is shown, together with a straight air-brake equipment, used for the instruction of motormen by electric railway companies to show in detail the operation of this brake.

Three hundred cars at the Buffalo Exposition were equipped with Christensen air brakes, and all cars operating within the grounds of the St. Louis Fair are controlled by this brake. It is an interesting fact to note that 11,000 are used in America, and more than 1,500 in Europe, Asia, South America, Africa and Australia.

Stationary and portable compressors are also shown. At block 46, Machinery Building, may be seen the National 1,500-kilowatt, 6,600-volt, three-phase, twenty-five-cycle alternator, running at eighty-five revolutions per minute. This generator is direct-connected to a 2,250-horse-power, compound vertical engine, and the entire machine represents one of the most modern generating units of the present day. This machine furnishes power to operate the immense streams of water which flow over the cascades, the largest artificial waterfalls in the world.



NATIONAL ELECTRIC COMPANY'S EXHIBIT AT ST. LOUIS.

The National Electric Company extends a cordial invitation to all visitors to call at its space and inspect its exhibit. Visitors are requested to register, and an attractive souvenir literature will be mailed to the home address of all interested callers.

### *The Sturgess Water-Wheel Governors.*

The Sturgess water-wheel governors have been especially designed for situations where space is limited or where it is desired to avoid the installing work incidental to a specially laid out equipment having governor, pump and receivers separately located. They are compact, can handle very heavy gates and all parts are readily accessible. These governors will completely shut the gate in one and one-half seconds and will feel a variation in the speed of less than one-half of one per cent. At the same time they produce no false movements of the gates and do not oscillate or race at any stage of the load. The movements are smooth and silent. The Sturgess governor is of the hydraulic class, all movements being produced by fluid pressure, either oil or water. The former is usually adopted where low heads are employed. In all cases the governor is considered as separate from the source of pressure supplied and is a self-contained apparatus adapted for placing in a position where the simplest or most advantageous method of connection to the gates is obtainable. The pumping system consists of a special oil pump and a steel receiver. These are not combined with the governor, but are adapted for location in any part of the plant. The governor consists of four essential elements: (1) a hydraulic cylinder having a shaft and piston adapted to move the gate; (2) a hydraulically operated main valve for admitting pressure to the hydraulic cylinder; (3) a centrifugal governor which controls the main valve, causing it to open in a direction which will produce a closing movement of the water-wheel gate when the speed is too high, or an opening movement when the speed is too low; when the speed is normal the valve is held in its middle position; (4) a secondary control which determines the amount the gate shall move for a given load variation. In operation, when the speed is normal, the governor weights ride half way between the extreme positions, both valves are then in the middle of their traverse, blocking all ports and leaving the gate at rest but open to any degree. The control cylinder is in the middle of its traverse, irrespective of the position of its piston. The slide valve covers both ports and the pulley is at its normal diameter. If the load is now decreased the speed will increase and the governor weights fly apart. This will cause the pilot valve to uncover ports leading to the front end of the main valve and the pressure thus produced will drive the main valve over in the same direction and as far as the pilot valve. This will admit pressure to the main cylinder and cause the gate to close. The secondary control prevents the closing movement of the gate continuing until the speed of the wheel falls to normal. If this were not the case, the gate would be closed too far, and there would be a continuous oscillation. The accompanying illustrations show a type "E" self-contained water-wheel governor and two of the governors in the plant of the Hudson River Water Power Company. The Turbine Engineering Company, New York and Chicago, is the selling agent for these machines.

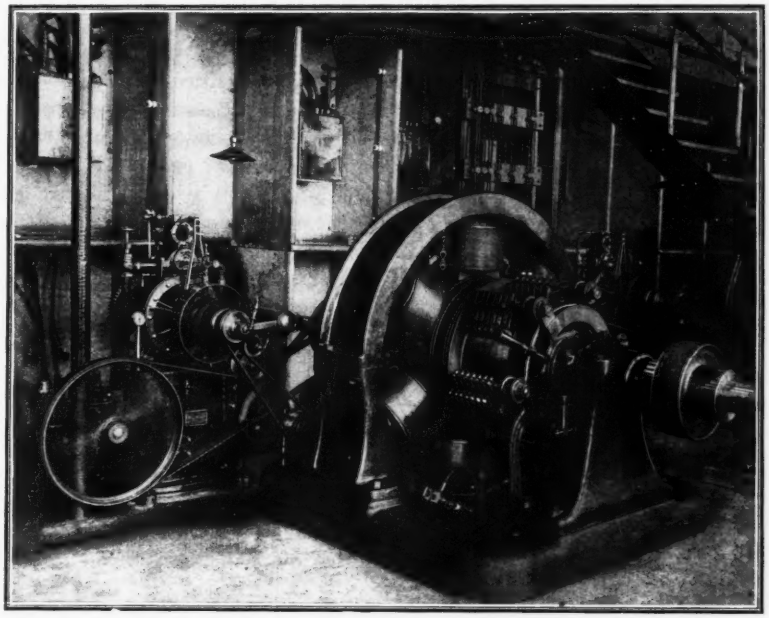


FIG. 2.—SELF-CONTAINED GOVERNORS IN PLANT OF HUDSON RIVER WATER POWER COMPANY.

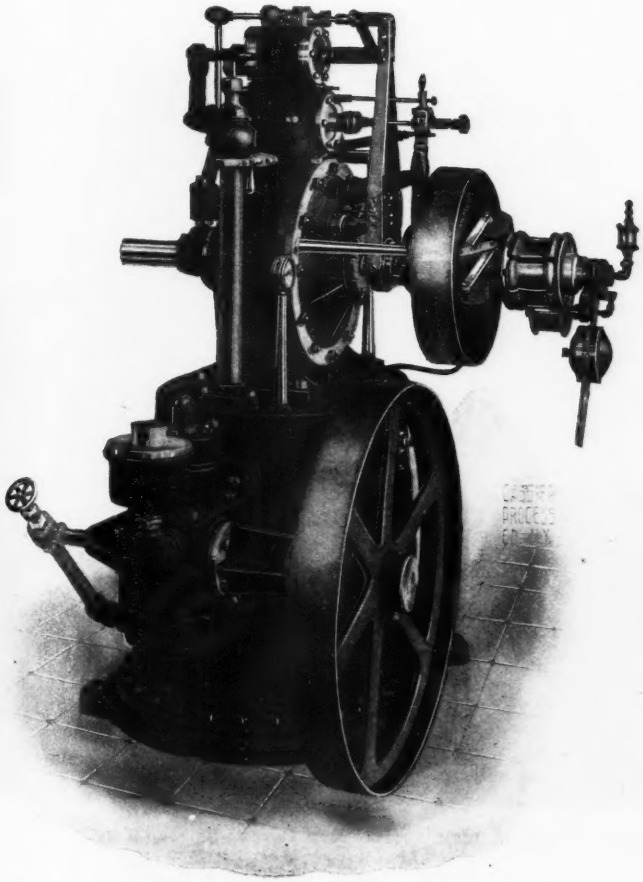


FIG. 1.—SELF-CONTAINED WATER-WHEEL GOVERNOR—TYPE "E."

### *The Rust Water-Tube Boiler.*

The Rust water-tube boiler, manufactured by the Rust Boiler Company, German National Bank Building, Pittsburg, Pa., was first introduced at the Minnequa steel works of the Colorado Fuel and Iron Company, at Pueblo, Col., and was designed and patented by a former chief engineer and general superintendent of that plant, from whom it takes its name.

Two designs of Rust boilers are being built, one designated as the "standard design" and the other as "style B design." Fig. 1 is a sectional view of the Rust boiler, standard design, arranged for an independent stack on top of setting.

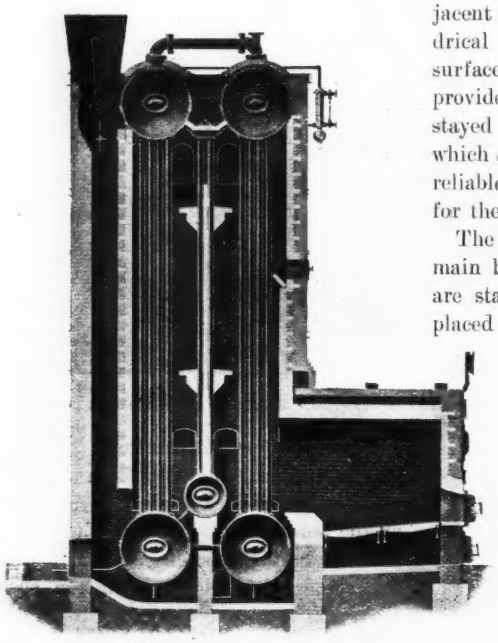


FIG. 1.—SECTIONAL VIEW OF RUST BOILER, "STANDARD DESIGN," ARRANGED FOR INDEPENDENT STACK CONNECTION.

This boiler consists of two steam and water drums, two mud drums and an auxiliary drum, each steam and water drum being placed directly above a mud drum, and connected with it by a bank of straight vertical tubes, the two mud drums being connected by a row of tubes. The auxiliary drum is placed above and between the mud drums, and is connected to one of them by a row of short tubes, and to a series of small headers by a bank of straight vertical tubes. These headers are placed between the steam and water drums, and are connected with them by short straight tubes or nipples. Each drum is fitted with a patent pressed tube sheet. The patent tube sheet used in the construction of the drums is formed by heating the plate while flat to the proper temperature, then pressed in a hydraulic press fitted with dies especially constructed for that purpose, the pressing being done at one operation. (Fig. 2.)

An important feature of the construction of these tube sheets is that between each pressed-up portion and those adjacent there remain undisturbed cylindrical portions of belts of the original surface of the drum. This construction provides a drum in which bent tubes or stayed surfaces are not necessary, and which at the same time is in every way as reliable as those in which it is necessary for the tubes to enter radially.

The holes for the tubes forming the main banks are so spaced that the tubes are staggered. The two inner rows are placed on a line between the tubes of the outside rows, thereby securing a more complete exposure to the hot gases, which, in order to reach the chimney, are forced to completely surround and envelop the tubes. The spacing of these tubes is such as to leave room enough between the tubes of the outside rows to remove the tubes of the inner rows, thus making it a simple operation to remove and replace any tube without interfering with any other tube or any of the brickwork. After a defective tube has been removed from the bank it is passed out through doors placed in the side of the setting for that purpose.

By the introduction of the auxiliary drum and central bank of tubes, the space necessarily left between the main bank of tubes is so utilized as to secure a serviceable and convenient support for the baffle wall, the tiles forming which are placed between and supported by the rows of tubes forming this bank, and owing to the consequent increased heating surface, a boiler of large capacity results, without additional floor space.

The boilers are made right and left-hand, and are arranged to be set singly or in batteries of two. Each drum is provided with a manhole in one end to permit of access to the interior of the drum, and in the top of each header there is a hand-hole through which the interior of the tubes of the central bank may be reached.

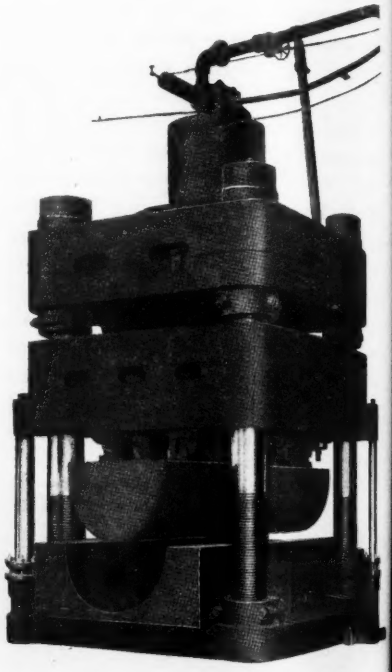


FIG. 2.—HYDRAULIC PRESS FOR STAMPING TUBE SHEET.

The steam spaces of the steam drums are connected by cross pipes of liberal dimensions. On top of each is an outlet, on which is placed a nickel-seated safety valve. The steam outlet is placed on top and at the centre of the rear

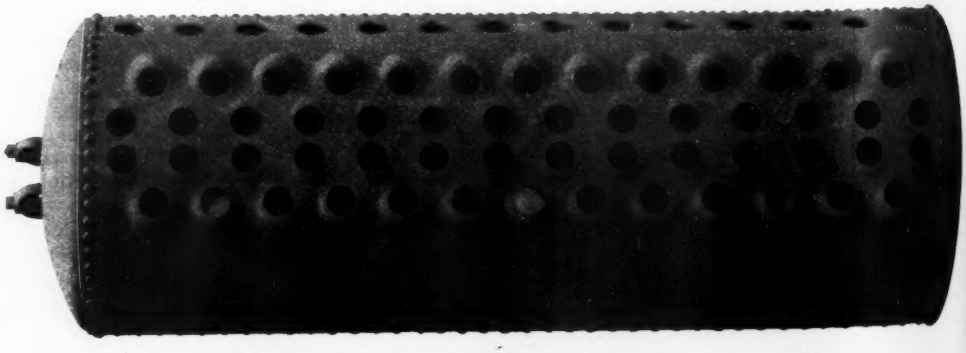


FIG. 3.—FORTY-FOUR-INCH DRUM, FITTED WITH PATENT PRESSED TUBE SHEET.

steam and water drum. The boiler is supported by four large cast-iron saddles resting on masonry foundations, one saddle being placed under each end of each mud drum, the saddles under one of the drums being placed on rollers, so as to permit of any slight movement that may be necessary on account of expansion.

The top of the central baffle wall is placed far enough below the headers to leave sufficient space for the products of combustion to pass from the front to the rear bank of tubes. There are also horizontal baffles or bracket tiles which project from the central baffle wall and serve to deflect the current of hot gases so as to force them toward and between the tubes of the main banks. The setting does not require any special shapes of brick. It is symmetrical and durable, and is firmly bound together by buck stays, rods and angle binders at the corners. A box-shape frame, made up of channels and plates, placed at the top of the setting and bolted to the corner binders, furnishes a rigid support for the breeching and stack. This also serves to firmly bind the brickwork at the top of the setting.

At one side of the setting, near the top, there are placed four small doors which furnish access to the interior of the brickwork, and through which the tubes are passed in and out should replacement become necessary. Doors with small self-closing openings, through which to insert a hose for blowing off the top of the tube sheets, are placed near the bottom of the setting, and other doors are furnished for securing access to the interior of the setting and for blowing deposits from the exterior of the tubes.

The furnace is of the exterior type, allowing a proper admixture of air and fuel for complete combustion before the gases reach the cooling influence of the heating surfaces. This type of furnace permits the adjustment of grate area to suit any kind of fuel, and the application of any style of grate bar or stoker.

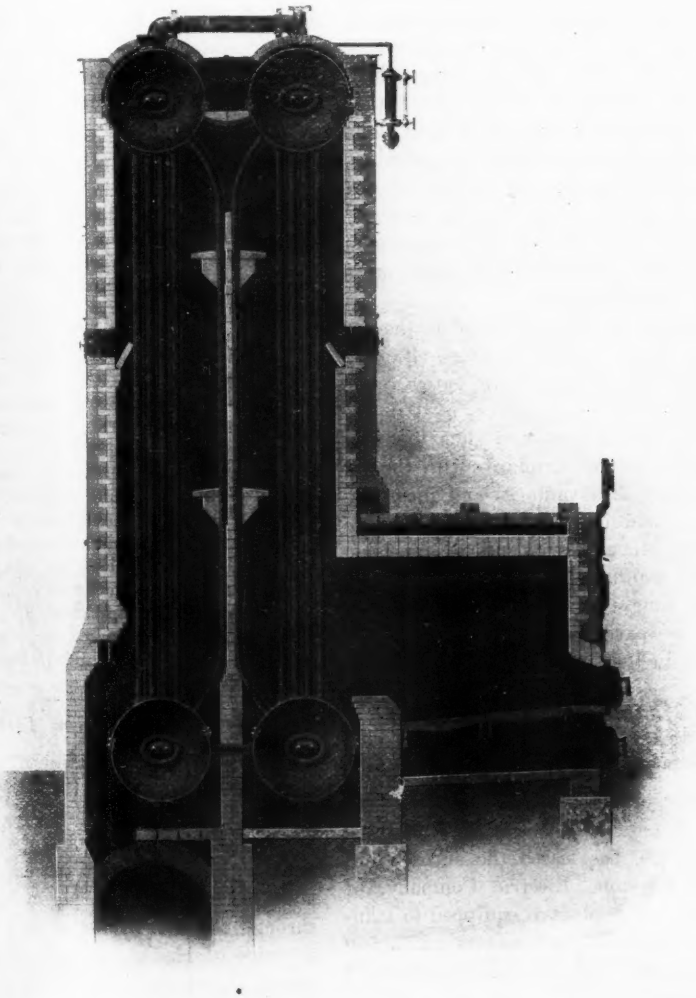


FIG. 4.—SECTIONAL VIEW OF RUST BOILER, STYLE "B," ARRANGED FOR UNDERGROUND FLUE CONNECTION.

The front is of cast iron of ornamental design, surmounted with a bracket in the centre for supporting the steam gauge, and is so arranged as to permit the application of gas burners.

A sectional view of the Rust boiler style "B," arranged for underground flue connection, is shown in Fig. 4. This boiler differs from the "standard design" only in the arrangement of the central or intermediate bank of tubes. The small drum and headers with the straight connecting tubes are eliminated in this design, and in their place are introduced two rows of curved tubes, between which is supported the central baffle wall.

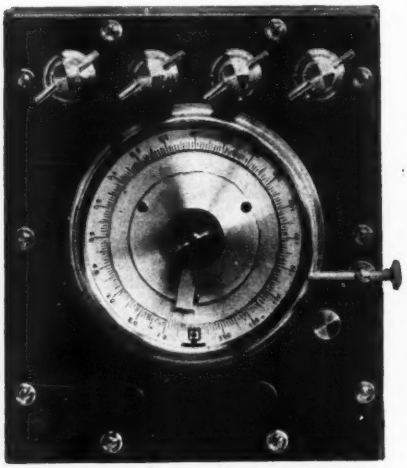
The style "B" boiler possesses most of the advantages peculiar to the standard design, except, as stated above, the central bank is composed of curved tubes. This central bank, however, only constitutes one-fifth of the tubes in the boiler. These curved tubes are not exposed to the most intense heat of the fire, and are so arranged as to ensure a positive rapid circulation throughout, consequently are not likely to become clogged with mud and scale and are not liable to burn out or require replacing. These curved tubes are all of the same shape and length. As in the standard design, any tube in style "B" boiler can be removed without disturbing any other tube or any part of the setting.

## *A New Standard for Checking Service Meters.*

The most important and most frequent use made of standard instruments in central stations is the checking of the wattmeters upon the service circuits, and it is the use for which they are the least adapted. Wattmeters, when properly tested, are checked under different loads, from one-fiftieth to one and one-half times their rated full-load capacity, and the range thus covered so greatly exceeds that of the portable standard instruments in general use that ordinarily three of these standards are required to check one service meter.

In the scale of the ordinary portable checking instruments the divisions grow narrower as the ends are approached, and the first and last divisions are little, if any, wider than the indicating pointer or the lines between the divisions, while the proportion represented by each division may be greatly increased, making it almost impossible to read the indications accurately. It is manifest that, to secure proper results, the checking instrument must be as accurately read as the one

which is being tested, and therefore, under the usual conditions, the readings of the checking standard must be confined to the central portion of the scale where the divisions are large enough to be read without the possibility of doubt. This necessitates the use of a standard of small capacity for checking the service wattmeter at light loads, one of moderate capacity for say one-half to full load, and a third standard for checking overloads. Two standards are often made to cover the range, but when this is done there is no certainty of the accuracy of the readings at the point where the change is made from one standard to the other, and the curve lines of test sheets frequently show aberrations attributable to no other cause.



NEW STANDARD FOR CHECKING SERVICE METERS.

Even after the readings are completed, there is an element of uncertainty introduced, by the difficulty in making the readings of the different standards coincide or "check up" to make a continuous record, for the instruments used in the same test, in nearly every case, vary slightly in accuracy, and the line of the resultant test curve is broken where the change is made, giving a result that is at least of doubtful value.

To facilitate rapid checking of integrating wattmeters, and to ensure accurate results, the Westinghouse Electric and Manufacturing Company has designed the special precision wattmeter illustrated herewith. It has the same general characteristics of high accuracy, freedom from influences of external fields, the closeness with which observations may be made, and ease of manipulation of the other Westinghouse instruments of precision, and has a special provision by which connections may be made for three different currents, of five, twenty, and 100 amperes maximum capacity respectively. The precision resistance or multiplier is used in connection with this instrument, which, with resistance in circuit suitable for 100 volts, will accurately measure quantities of from 10 to 10,000 watts and proportionate amounts at other voltages.

This instrument is easily manipulated. The construction of the binding-posts facilitates making quick connections and ensures good contact. When current is passed through the circuit the sight wire moves to the right, and is brought back to zero by turning to the left the central knob, which moves the vernier head along the scale. A fine adjustment is obtained by the knob at the side. Readings are made in tenths of a division without estimation, giving, in the instrument shown, 2,000 readable deflections on a five-inch circular scale.

In designing this instrument, the intent has been to provide a single checking standard that will cover the entire range of all the service wattmeters used in the ordinary installation, and thus to avoid the use of several standards with the accompanying disadvantages and inconvenience in handling. By agreeing to keep this and other instruments of precision correctly calibrated for five years, it is further sought to eliminate any trouble caused by inaccuracy or doubt of the correctness in the standards themselves.

## *To Manufacture Dynamos and Motors.*

The Burke Electric Company, which was incorporated recently under the laws of the state of New Jersey with a capital of $150,000, has leased the entire plant of the Keystone Electric Company, of Erie, Pa. The plant is equipped to manufacture dynamos and motors up to 500 kilowatts, and slow-speed direct-connected generators.

The manufacture of dynamos and motors will be continued under the patents of Mr. James Burke. Machinery has been built under these patents for the past six years in Europe by the Bergmann Electrical Works, of Berlin, Germany.

The personnel of the company includes the president, Mr. James Burke; manager and superintendent of manufacture, Mr. Gustave Faure; electrical manager, Mr. George H. Winkler; manager of the selling organization, Mr. Herbert B. Coho; and the accounting department will be continued under the direction of Mr. Irving Blake.

Mr. Burke has had a long and successful career in the designing and manufacture of motors and generators. He was, for some time, associated with the General Electric Company and its predecessors, and following his connection with this company was engaged in consulting electrical engineering in New York city. He traveled to Europe to supervise the manufacture of dynamos and motors, under his own designs, at the factories of the Bergmann Elektromotoren und Dynamo Werke, at Berlin, Germany. This company later became the Bergmann Elektricitats Werke. Of this company Mr. Burke was technical director and chief engineer. He will continue to be the consulting engineer of the Bergmann company, while manufacturing American electrical machinery under his own name.

Mr. Faure, the manager and superintendent of manufacture, for the past fourteen years has been connected with the General Electric Company. He has been associated with the Schenectady works, and for the last eight years was at the Paris factory of the Thomson-Houston Company.

Mr. Winkler, the electrical manager, has had a wide experience in engineering, and for the past five years has been connected with the Bergmann company in Berlin as first assistant engineer.

Mr. Coho is probably one of the best known and most capable men of any selling organization. He has a very wide acquaintance in the engineering fraternity, and as vice-president of the Keystone Electric Company did very much to increase the sales of the company's apparatus.

## *A Transverse Steam Turbine.*

A description of a transverse steam turbine, constructed on the Patschke system, and analytical discussions of the theory contained in a pamphlet has just come to hand. In this turbine steam is admitted at the centre, and in its passage through the wheel flows axillary through a series of blades. In some types proposed, the steam, after reaching the extreme end of the moving part, is returned underneath, thus making almost a complete cycle.

A most interesting comparison is possible to visitors to Machinery Hall, at the World's Fair, St. Louis. Just opposite the immense Allis-Chalmers-Bullock 5,000-horse-power steam electric unit are the smallest operating steam engines in the fair. These stand in a glass case across the aisle from the large engine, in the space occupied by the International Steam Pump Company. Two of these are now operating, each working a direct-connected pump and throwing tiny streams into a copper tank which stands between them.

### The International Electrical Congress.

Quite a large number of the foreign visitors, en route to St. Louis, to participate in the International Electrical Congress, arrived in New York city during the week. Most of these were members of the Associazione Elettrotecnica Italiana, and they were entertained by members of the local reception committee, visiting several points of interest in a body. A number of the visitors proceeded to Boston where it was purposed that a meeting should be effected with the British Institution members scheduled to arrive at a later date. The consolidated party from Boston is scheduled to arrive in New York early in the morning of Sunday, September 4.

Among those who arrived last week were: Professor Moisè Ascoli, Professor Guido Grassi, Professor Luigi Lombardi, Camillo A. Curti, Ferdinando Lori, Amatore Maffezzini, Auguste Silva, Gian Carlo Stuckey, Gustave Snoeck, Giorgio Sauterelli, Silvio Magrini, Emilio Rietti, Ferderico Cazini, G. Ponzio, Virgilio Bellini, Vietro Vinelli, Jorge Newberry, Ing. Edoardo Ambrosano, Ing. Giovanni Barosi, Ing. C. Vincenzo Brazzola, Ing. Alfonzo Carelli, Ing. Nicostrato Castellini, Ing. Filippi Cavalieni, Ing. Filippo Danioni, Ing. Edoardo Egger, Professor Gino. Fano, Ing. Luigi Galimberti, Dr. Ettore Gamba, Gian Teodoro Giorgetti, Ing. Francesco Giudice, Ing. Emanuele Jona, Ing. Arnaldo Odazio, Augusto Pancaldi, Ing. Antonio Pesenti, Ing. Alberto Picchi, Luigi Pizzi, Ing. Eugenio Prandoni, Ing. Luigi Robbo, Ing. Alberto Rubini, Ing. Ulderigo Segre, Giuseppe Stramezzi, Ing. Gianfranco Tosi, Achille Venzaghi, Robert Prenf and D. A. Palmier. Robert Kaye Gray, president of the British Institution of Electrical Engineers, and George C. Lloyd, were among the arrivals from London, who registered at Institute headquarters.

On Sunday, September 4, the visitors and members of the American Institute of Electrical Engineers will be guests of Mr. J. G. White on a steamer ride up the Hudson river, and to Dreamland, Coney Island.

On Monday (Labor Day), September 5, an inspection of the Rapid Transit subway will be made. Cars will be furnished by courtesy of the Interborough Rapid Transit Company, and the trip will include visits to the large power-houses operated by this company.

On the evening of Monday, September 5, the American Institute of Electrical Engineers, cooperating with the New York reception committee, will give a banquet to the Institution of Electrical Engineers, to the visiting officers and members of the Associazione Elettrotecnica Italiana and other friends from abroad, at the Waldorf-Astoria, at seven o'clock, in the grand ball-room, preceded by a reception in the Astor gallery, at 6.30 o'clock. In view of the fact that the special train for St. Louis leaves early next morning, the speaking will be limited and brief.

The special train will leave the Grand Central station of the New York Central & Hudson River Railroad at 8.45 A. M., on Tuesday, September 6. The party will then proceed to St. Louis, stopping at the following places, where entertainment will be provided by local committees of the American Institute of Electrical Engineers: Schenectady, Tuesday, September 6; Montreal, Wednesday, September 7, and Thursday, September 8; Niagara Falls, Friday, September 9; Chicago, Saturday, September 10; St. Louis, Sunday, September 11, to Saturday, September 17.

The International Electrical Congress will convene at the Music Hall of the Coliseum, St. Louis, at 9.30 A. M., on Monday, September 12, 1904. The Music Hall is situated at Olive and Thirteenth streets, in the city district of St. Louis. All congress members are invited to attend the meeting, which, unlike section meetings, will be open to the public.

It is intended that after the opening ceremonies, the convention will immediately divide into sections, the section halls being on the second floor of the same building. The bureau of information and the offices of the secretary and treasurer will also be in the Coliseum Building. On Tuesday, Wednesday, Thursday and Friday the sections will meet on the second floor of the Coliseum from 9 A. M. to 1 P. M.

The committee of organization of the congress was appointed by the president of the St. Louis Exposition in June, 1903. The committee held its first meeting in July, 1903. In response to invitations to join the congress, 1,956 acceptances have been received, of which 1,560 are from North America and 396 from other countries. Over 1,300 certificates of membership have been issued to persons who have already become members by forwarding their subscriptions.

The committee of organization has issued at the suggestion of the section officers, invitations to well-known electrical workers all over the world, asking for papers to be read before the congress. In response to these invitations, about 170 papers have been promised for the congress, and seventy-seven are already in hand.

On Wednesday, at 10 A. M., the annual convention of the American Institute of Electrical Engineers will be formally opened at Festival Hall, in the grounds of the Louisiana Purchase Exposition.

In addition, the following societies will hold conventions:

American Physical Society, September 16.

American Electrochemical Society, September 13 and 15.

The American Electrotherapeutic Association, September 15.

The International Association of Municipal Electricians, September 15.

The National Electric Light Association, the Association of Edison Illuminating Companies, and the United States navy department will send delegates to the congress.

The governments of Austro-Hungary, Italy, Switzerland, Norway and Sweden, Australian colonies, Brazil, India and Mexico have appointed delegates, as have the following foreign national organizations: the British Institution of Electrical Engineers, La Society Internationale des Electriciens, Associazione Ellettrotecnica Italiana, and Oesterreichische Elektrotechnischer Verein.

At the conclusion of the congress, the special train will leave St. Louis by the Pennsylvania lines, at 8 P. M., Saturday September 17, and will arrive at Pittsburg, Sunday, September 18, at 3 P. M. Sunday and Monday, September 19, will be spent in Pittsburg; Tuesday, September 20, in Washington; Wednesday, September 21, in Philadelphia, leaving that city at 3.30 P. M., arriving in New York the same day, two hours later.

### Turbine Liner Launched.

The Allan Line steamer Victorian was launched at Belfast, Ireland, on August 25. This is the largest turbine vessel ever constructed, and its performance will be very closely watched. It is expected that the boat will be ready for service before the end of the year. She is 540 feet long, has a sixty-foot beam and a depth of forty feet six inches. The tonnage is about 12,000, and it is expected that 10,000 horse-power will be developed. A wireless telegraph apparatus will be part of the equipment.

# CURRENT ELECTRICAL NEWS

## *DOMESTIC AND EXPORT.*

WEST VIRGINIA TRACTION PROPERTY SOLD—Arrangements have been completed for buying outright all the local traction lines in Wheeling, W. Va., representing a total of 107 miles. The deal involves the payment of about $10,000,000. It is said that Mr. John A. Howard, a Wheeling business man, has promoted the enterprise for some eastern capitalists.

LIGHTING COMPANIES TO CONSOLIDATE—Negotiations are being carried on with the purpose of merging the interests of the Portland Gas Company and the Portland General Electric Company, of Portland, Ore. The object of the merger is said to be a reduction of expenses through operating under a single management. The Portland General Electric Company is capitalized at $4,000,000, and has about $2,000,000 in bonds outstanding. The Portland Gas Company is capitalized at $1,000,000.

MERGER OF TRACTION LINES—Formal action has been taken at Springfield, Ohio, by which the following traction lines have been merged: Columbus, London & Springfield; Dayton, Springfield & Urbana; Urbana, Bellefontaine & Northern, and Springfield & Western. In the execution of the plan, the stockholders authorized a consolidated mortgage to secure the issue of five per cent forty-year gold bonds amounting to $750,000. The new corporation will be known as the Union Traction Company.

STORM WARNINGS BY WIRELESS TELEGRAPH—The first step in the direction of carrying out the recommendations of the board on wireless telegraphy, whose report was recently approved by President Roosevelt, has been made by the transfer of ocean meteorology from the navy department to the weather bureau, under the department of agriculture. The change is considered to be indicative of an advance in the general plan of utilizing wireless telegraphy for government purposes. It is thought that the system of wireless telegraphy will prove a great advantage in keeping vessels at sea informed of coastwise storms.

THE CHICAGO (ILL.) MUNICIPAL LIGHT PLANT—The annual report of City Electrician Ellicott, now in preparation, estimates that the Chicago municipal electric lighting system earns yearly for the city $297,048. In sixteen years of municipal ownership and operation, the city has spent for construction and operation of its electric lighting system $3,720,099. In 1895 city lighting cost $1,098,220, and light equal to 3,964,000 candle-power was furnished. By 1900 the cost had fallen to $919,163, and the candle-power had risen to 9,513,400. In 1903 the cost was $916,212, and the lamps, of all kinds, were giving an equivalent of 12,269,000 candle-power of illumination.

PHILIPPINE ELECTRICAL POWER PROPOSITION—The construction of a number of water-power plants is projected in Manila, P. I., for the purpose of transmitting electrical energy to the capital of the islands, for use in the operation of the new electric traction system which is expected to be in operation this year. The current will also be used for lighting purposes, and for the motor load. The bureau of engineering is now considering the question of harnessing Botocan falls, on the Caliraya and Lomot rivers, in the province of Laguna, and the Angat river, at Bulacan. It is estimated that between 30,000 and 40,000 horsepower can be generated by this plant.

MEXICAN ELECTRICAL NOTES—It is understood that plans are under way to construct an extensive electric traction system in Mexico, in the city of Chihuahua, state of Chihuahua. Options have been secured on the existing horse-car tramways in the city, and on one of the steam roads. These will be converted into electric traction systems immediately, if the present plans go through. The horse line is operated by the Compania Tranvia de Chihuahua. It is about six miles long. The Mineral Railroad, a steam road between Chihuahua and Santa Eulalie, a distance of about fifteen miles, is also to be changed over to an electric system. It is stated that a large water-power plant will be built on the Tuxpan river, in the state of Jalisco. Electricity will be generated for operating sugar mills, mining machinery, and for supplying the towns and ranches of the vicinity.

WESTERN MASSACHUSETTS TROLLEY ENTERPRISE—A movement is under way to purchase and control twenty different trolley roads in various sections of Massachusetts and northern Connecticut. This will also include the construction of a large number of amusement parks in connection with the electrical enterprises. The United Gas Improvement Company, which corporation is considered to be in control of the Connecticut Railway and Lighting Company's network of roads in that state, is said to be largely interested in the negotiations. The purchase of lines and the construction and improvement of parks will involve an expenditure of some $7,000,000. The plans under discussion include the erection of a large power station near Greenfield, on the Connecticut river, with feeders to various substations near cities where the trolley roads now exist.

## *LEGAL NOTES.*

IN THE UNITED STATES CIRCUIT COURT, District of New Jersey, judgment has been rendered in favor of Pass & Seymour, Incorporated, Solvay, N. Y., for damages and costs against Duncan Mackenzie's Sons & Company, the proprietors of the Union Porcelain Works, Trenton, N. J., for infringement by the latter of two patents covering the well-known attachment plugs made by Pass & Seymour, Incorporated, for several years. Judgment has also been rendered in favor of Pass & Seymour, Incorporated, and Duncan Mackenzie's Sons & Company placed under injunction.

SUIT FOR INFRINGEMENT OF THE CALCULAGRAPH—In the Circuit Court of the United States, District of Massachusetts, in the suit of the Calculagraph Company *versus* John C. Wilson, the opinion of the Court, as delivered by Justice Hale on August 16, 1904, was that a decree be entered for the complainant for an injunction and for an accounting with costs. This suit in equity was for infringement of the first claim of letters-patent No. 424,291, dated March 25, 1890, to Emery N. Hamilton, for apparatus for recording measurements of time, space or quantity; also for infringement of claims one and two of letters-patent No. 583,320, dated March 25, 1897, to Henry Abbott, for calculagraph. In the course of the opinion, the Court states that it is persuaded by the testimony that the defendant, in producing his device, was endeavoring to avoid infringement, and, at the same time, to imitate, as closely as possible, the devices found in the complainant's machine. The Court holds that the defendant has not succeeded in his attempt to avoid infringement of the principles found in the calculagraph. After reviewing prior cases of a similar character, the Court concludes that the machines perform substantially the same function, in substantially the same way, to obtain the same result. Without deciding how far the calculagraph is a pioneer invention, the Court holds it is entitled to a range of equivalents broad enough to bring the timometer clearly within the range of infringement. The Court is satisfied that the claims of both patents in the controversy are valid, and that they have been infringed by the defendant.

## *OBITUARY NOTICE.*

JOHN LOWBAR WELSH, formerly president of the Union Traction Company and the Philadelphia Traction Company, of Philadelphia, died at his home in Whitemarsh, Pa., on August 22, at the age of sixty-two.

## ELECTRIC RAILWAYS.

NEWARK, N. J.—The Union Township committee has granted a franchise to the Morristown & Elizabeth Trolley Company.

YORK, PA.—The Steelton, New Cumberland & Mechanicsburg Railway Company will extend its lines from Lewisburg to Newburytown.

NEWARK, N. J.—What is practically a new trolley line has been put in operation between Newark and Hackensack through a traffic arrangement.

MOBILE, ALA.—The Mobile Light and Railroad Company will extend its suburban routes by the construction of a road from Mobile to Magazine Point.

OAKLAND, NEB.—The right of way for the construction of an electric road from Tekamah and Decatur has been secured, and it is stated that work will begin this fall.

BUFFALO, N. Y.—A deal has been closed by which the Buffalo, Gardenville & Ebenezer Railway and the Buffalo, Hamburg & Aurora Railway are to be consolidated and operated as one system.

BATTLE CREEK, MICH.—Work has been begun on the survey for the Battle Creek and Coldwater electric line, which will pass through Athens, Union City and Coldwater, a distance of forty miles.

LAMBERTVILLE, N. J.—Work has been started on the New Hope branch of the Pennsylvania & New Jersey Traction Company. The company expects to have the road completed next January.

OWENSBORO, KY.—A deal has been consummated whereby James H. Parrish, John G. Delker, of Owensboro; E. Rice, of Louisville, and A. S. Williams, of Pinkneyville, Ill., become the owners of the Owensboro Street Railroad.

DUXBURY, MASS.—It is reported that plans are being considered for the construction of an electric railroad from Rockland and Brant Rock to Kingston. The road will go through a territory that is not touched by the steam road, and the length will be about twenty-six miles.

ST. JOSEPH, MO.—The St. Joseph, Albany & Des Moines Railroad, the proposed electric line to extend from St. Joseph to Des Moines, through the Missouri counties of Buchanan, DeKalb, Gentry, Worth and Harrison, has filed articles of incorporation with the secretary of state, with a capital of $800,000.

LANCASTER, PA.—The Philadelphia, Coatesville & Lancaster Passenger Railway Company has filed the route of a proposed extension through southern Lancaster County, thence across Octorail creek to Chester County, and ending at Oxford. The present terminus is at Georgetown, Lancaster County.

COLORADO SPRINGS, COL.—At a meeting of directors, J. R. McKinnie, of Colorado Springs, was elected president of the Denver-Boulder Interurban Electric Railway, which proposes to expend $10,000,000 on lines. S. Simpson, of Cleveland, Ohio, and Shirley Moore, of Louisville, Ky., are members of the board of directors. Right of way has been secured and work will begin this fall.

ELKTON, MD.—Actual construction work on the electric railway that will connect Elkton with Wilmington and other points has been started, and it is stated that part of the line will be in operation by the end of the year, and the whole line completed by the first of next June. After the main line between Elkton and Wilmington is completed a branch will be built to Oxford, Pa.

ORANGE, N. J.—Plans are under way for the construction of a trolley line from Newark to Morristown, eventually to be continued to Easton, Pa. The company will be known as the Lehigh Valley Traction Company, and is composed largely of Pennsylvania capitalists. The route will be one surveyed thirty years ago for the New Jersey Central Railroad. From Morristown it will run through Afton, Hanover, Moorehouse Town and Livingston.

CLEVELAND, OHIO—The Cleveland Electric Railway Company is extending its Kinsman street line to Warrensville township through Newburg. Formerly the line ran to Newburg only, and from that point on there was a single track used by the Northern Ohio Traction Company. The line now will be double-tracked and regular city service extended to the township line, a distance of a little over six and a half miles from the Public Square.

RACINE, WIS.—It is stated that Boston capitalists desire to build an electric railway line from this city to Lake Geneva and Elkhorn in Walworth County. If the right of way can be obtained the line will run from Racine west to the summer resorts at Eagle Lake and Brown's lake near Burlington, and then to Elkhorn and Lake Geneva.

FORT WAYNE, IND.—The Fort Wayne Electric Light and Power Company, with $500,000 capital stock, has been merged with the Fort Wayne & Southwestern Interurban. These companies will be taken over later by the Fort Wayne & Wabash Valley Traction syndicate. E. C. Werner, of New York, has been elected president of the company. A joint power station will be built soon at a cost of about $1,000,000.

AURORA, NEB.—Articles of incorporation have been filed with the county clerk by the Omaha & Nebraska Central Railway. The names of the incorporators are Anthony Texter, Chas. J. Helm, Chas. H. Deeter, Frank J. Helm and Anthony G. Buski. The authorized capital of the company is $1,500,000. It is the purpose of the company to construct and operate an electric railway from Omaha to Hastings. The promoters are Chicago men.

ALTON, ILL.—Within a period estimated at ninety days, East St. Louis will be connected with Alton by a trolley system which will enter East St. Louis at the Black bridge and will run over the lines of the East St Louis Electric Railway to the Eads bridge, where passengers will be transferred to St. Louis. Arrangements have been completed for traffic service and the furnishing of a large portion of the power needed, which will come from the plant of the East St. Louis & Suburban Electric Railways.

MANKATO, MINN.—The Mankato Railway, Light and Power Company has been organized by citizens with $50,000 capital, and the council has granted it a franchise to build a street railway in the city. It is proposed to build an interurban line to Eagle Lake and St. Clair and possibly to Madison Lake. The company has entered into a contract with the Municipal Bond and Securities Company, of New York, to furnish the capital needed and to build the line. It will do commercial lighting and furnish power as well as operate the street car line. Surveys have already been made, and half of the county right of way secured.

ASHEVILLE, N. C.—Work on the electric railway from Boone Ford, in Mitchell County, to Burnsville, has been commenced and the work will be pushed to completion as rapidly as possible. The distance is nine miles, and the right of way for the line has been secured and the entire survey made. It is expected that grading will be completed in December next. The proposed electric line will connect at Boone Ford with the road running from Johnson City to Spruce Pines, and will operate as both a freight and passenger road. This road is being built by Chicago capitalists, who will use power from the National Graphite Company's plant on the Toe river. This plant is located two miles from Boone Ford, and is sufficient to furnish 400 horse-power per day. It is understood to be the intention of the promoters to ultimately extend the road to Asheville, thus connecting with both the Southern Railway and the South & Western.

SALISBURY, MD.—The Wicomico Electric Railway Company, incorporated by the last legislature and granted a franchise covering Wicomico County for a trolley system, has organized by the election of Thomas Perry, president; C. R. Disharoon, vice-president; H. L. Brewington, treasurer, and W. S. Gordy, Jr., secretary. The following constitute the executive and finance committee: Thomas Perry, S. A. Graham, W. J. Staton, W. S. Gordy, Jr., and Marion A. Humphreys. The purpose of forming the organization, the president states, is to enable the concern to negotiate with northern capitalists, who have tendered their services to finance the road. The present plan is to build a trolley street car system in Salisbury and an extension of the line to Bivalve, either *via* Hebron and Quantico or by the most direct route to that point. There will be no effort at this time to extend the line farther. The franchise grants exemption from taxation for five years and a right of way on the country roads, subject to approval and consent of the county commissioners.

### TELEPHONE AND TELEGRAPH.

STOCKPORT, IOWA—The Farmers' Mutual Telephone Company has been incorporated with $10,000 capital.

BEAUMONT, TEX.—The Southwestern Telephone and Telegraph Company is laying 20,000 additional feet of cable.

GREENSBORO, N. C.—The Southern Bell Telephone Company will erect a new three-story exchange, and will also place its wires underground.

ALTON, ILL.—The Central Union Telephone Company is preparing to rebuild its lines in Alton and to install a complete automatic system.

DUBUQUE, IOWA—The Stacyville Telephone Company has sold out to the Eureka Telephone Company, of Osage, the consideration being $14,500.

WATERLOO, IOWA—The Iowa Telephone Company will erect an exchange building, two or three-story, thirty by sixty feet, and will do considerable subway work.

EVANSVILLE, IND.—The Cumberland Telephone Company has asked the board of public works for a forty-year franchise, for which it agrees to pay $100,125.

ANN ARBOR, MICH.—The Washtenaw Home Telephone Company has opened up connections with Jackson, and will thus gain access to the western part of the state.

HUNTSVILLE, ALA.—The planters in the Green Grove neighborhood have organized a company with $2,000 capital to furnish themselves telephone connection with this city. There are about twenty subscribers.

DUBUQUE, IOWA—The Tri-State Telephone Company is perfecting plans for the construction of a submarine cable for the extension of the line to East Dubuque. It will require 2,375 feet of submarine cable to span the river, besides 3,600 feet of aerial cable.

DENMARK, S. C.—The Bell Telephone Company has completed the installation of a local telephone exchange in this town. A good number of subscribers have been secured, several lines extending beyond the limits of the town, taking in several plantations.

BALTIMORE, MD.—The Maryland Telegraph and Telephone Company has been given the city's telephone contract by the municipal board of awards. The contract is for three years, at $720 a year for the trunk lines and two cents each for calls outside the municipal buildings.

BRUNSWICK, ME.—The New England Telephone Company is making extensive additions to its exchange here. A new switchboard, having room for several more operators than the present one, will be installed shortly. About seventy-five contracts have been signed for new telephones, and the instruments will be put in as soon as the wires can be strung.

HOLLEY, N. Y.—At an adjourned meeting of the board of trustees of the village a franchise was granted to the Inter-Ocean Telephone Company to build a telephone exchange. The franchise was granted to the company by reason of the fact that it connects with all of the rural telephone systems to the north and west of Holley and with Brockport and Byron independent telephone exchanges.

PLAINFIELD, N. J.—The New York & New Jersey Telephone Company is making many improvements to its system in the vicinity of Westfield. A new switchboard will be installed and connection made with Harlingen and Belle Mead. The local company heretofore covering this part of Somerset County has been taken over by the New York & New Jersey company, and there will be a general improvement in the service.

DULUTH, MINN.—The Zenith Telephone Company is now expending between $75,000 and $100,000 in enlarging and improving its plant and adding to its capacity. When the work is complete the company will be in a position to handle 1,000 more subscribers, making the total capacity of the plant about 3,500. At present about 2,500 names are on the books. A crew of 100 men is now employed in making improvements in various parts of the city, establishing new lines, laying conduits, etc. A complete party line system is also being put in. About $10,000 is being spent in laying underground conduits.

JACKSON, MISS.—At the annual stockholders' meeting of the Citizens' Telephone Company the following directors were elected: J. C. Richardson, Z. C. Eldred, T. E. Barkworth, George W. Carter, W. H. Maloney and E. W. Barber, of Jackson; J. B. Ware, W. J. Stuart, R. D. Graham, C. E. Tarte and E. B. Fisher, of Grand Rapids, and T. Bromley, Jr., of Muncie, Ind. The annual report showed the company to be in excellent financial condition. The number of telephones in actual use is 2,138, an increase of 300 during the year. On the adjournment of the stockholders' meeting, a majority of the new directors being present, the board organized by electing J. C. Richardson, president; E. W. Barber, vice-president, and E. B. Fisher, secretary and treasurer.

FARMINGDALE, L. I.—The New York & New Jersey Telephone Company has completed the laying of its ducts for underground cables from Hempstead to Farmingdale, and now has a continuous line of subways for its main cables from Brooklyn to Farmingdale. The wire cables will be drawn through the ducts soon, and when that is done all of the lateral lines from Babylon, Amityville, Freeport, Northport, Huntington, Oyster Bay, Glen Cove and other north and south side villages will be feeders for the cable line. All wires east of this place will also be brought to these underground conduits, which can be operated without interruption in all kinds of weather. It is the intention of the company to continue the work as far east as Riverhead. This, it is said, will ensure a much better service than at present.

NEW ORLEANS, LA.—The Cumberland Telephone Company is making many improvements in its long-distance connections with Memphis, Shreveport, Meridian and Mobile and the many towns and cities intermediate to these points and New Orleans. A direct line is to be built within a short time to Shreveport, *via* the Texas & Pacific to Alexandria, and from there on over the new Louisiana Railway and Navigation Company route. Four new circuits are to be built over the Northeastern into Meridian. A new circuit is to be built over the Illinois Central into Memphis, and gangs are now at work increasing the facilities for communication with Mobile. At present messages from Shreveport to New Orleans have to come by way of Vicksburg; those to or from Meridian by way of Jackson, while the number of circuits between New Orleans and Memphis and between New Orleans and Mobile, is often insufficient.

### PERSONAL MENTION.

PROFESSOR WILLIAM G. RAYMOND, of Rensselaer Polytechnic Institute, Troy, N. Y., has been asked to assume charge of the engineering department of the Iowa State University.

MR. H. C. SPAULDING, assistant sales manager of the Triumph Electric Company, Cincinnati, Ohio, has been placed in charge of a recently opened branch office at Baltimore, Md.

CAPTAIN JOHN A. GALBREATH, confidential clerk of the New Orleans postmaster, has resigned, and will go to Jackson, Miss., to take charge of the Western Union Telegraph Company's office in that city.

MR. WILLIAM BARCLAY PARSONS, consulting engineer of the Rapid Transit Commission, returned last week from England, where he has been in the service of the company which is building the London underground railway.

MR. CHARLES C. BENSON, formerly superintendent of the Citizens' Street Railway, of Newburyport, Mass., and who for two years has been general manager of the San Juan Electric Light and Traction Company, has returned to the United States.

MR. E. R. CARICHOFF has opened an office at 20 Broad street, New York city, for practice as a general consulting engineer. A specialty will be made of electric elevators and motor control and examinations of inventions and patents. Mr. Carichoff received the degree of master of arts at the Washington & Lee University, studied for two years under Professor Roland G. Johns Hopkins University, was associated with Mr. Frank J. Sprague in the development of controlling apparatus of electric

elevators and for the multiple unit system of electric railways. He has been retained by the General Electric Company and for a number of years past has been associated with the Otis Elevator Company, New York.

MR. CHARLES ALGERNON PARSONS, the English engineer, who developed the steam turbine, adapting it to electrical and marine purposes, was presented with a gold medal in behalf of the Associated German Engineers at a recent meeting of the British Association for the Advancement of Science.

MR. J. R. BIBBINS has reprinted and is distributing in pamphlet form a paper presented at the meeting of the New England Railroad Club, March 8, 1904, entitled "The Fitness of the Steam Turbine for Heavy Power Service." This paper includes curves and illustrations of the steam turbine in its various aspects.

MR. RALPH D. MERSHON, consulting engineer, New York, has published in *Cassier's Magazine* an article with illustrations of the electrical transmission plant at Shawinigan Falls, Canada. Some difficult feats in engineering were attempted and successfully accomplished and the plant stands as a monument to Mr. Mershon's ability.

MR. JOHN O. CROCKETT was recently elected general superintendent of the southwestern district of the Rock Island system, including the St. Louis, Kansas City & Colorado line. Mr. Crockett began his railroad work at the age of seventeen. He served successfully as messenger, train despatcher and clerk to the general manager on various lines. His last position was as superintendent of telegraphy and mails on the Chicago, Rock Island & Pacific.

MR. W. A. STADELMAN, eastern manager of the Brown Hoisting Machinery Company, is not only very active in his industrial field, but takes quite an interest in the affairs of the Lambs' Club, of this city. Mr. Stadelman is chairman of the house committee and is also chairman of the committee that is erecting the club's new building on West Forty-fourth street. The corner-stone of the new structure was laid on Wednesday of last week with appropriate ceremonies. The house will be six stories, and will cost $180,000 exclusive of the land, which cost $80,000.

MR. F. V. HENSHAW, who has for a number of years been active in the management of the engineering and manufacturing departments of the Crocker-Wheeler Company, Ampere, N. J., has resigned from that company and has planned to take a well-earned rest before undertaking new work. In addition to a large part of the management of the engineering department, Mr. Henshaw has had entire charge of the estimating and installation work of this company and has devoted much study to engineering economies in a wide variety of manufacturing industries.

LIEUTENANT GODFREY L. CARDEN, United States revenue cutter service, and superintendent of arsenal tools, department of machinery, World's Fair, St. Louis, was in New York city this week conferring with officials of the principal machinery and engine building houses with reference to "Machinery Day" at the exposition—September 10 next. Lieutenant Carden says that the machine tool display is extraordinarily fine; that reports by special commissioners have been made upon it to the various governments, and that in consequence of these reports special commissions are now and have been arriving during the past month to further and more fully investigate these topics. Commissioners are now on the ground from Austria, Japan, Brazil, Norway and Italy, and one body of commissioners is making its selection for an entire arsenal equipment from the tools on exhibit in Machinery Hall. From a business standpoint the machine tool exhibitors are securing excellent results from their showing. Acting in common with the exposition executive, the exhibitors in Machinery Hall are arranging for a special "Machinery Day" on September 10, and from a number of the large machinery centres of the country special trains will be run to St. Louis for the purpose of taking the leading workmen of the shops. A number of the firms have arranged to send on groups of their head workmen for the educational advantages to be derived. Lieutenant Carden says that it is not generally known that the operation of the great power plant system at St. Louis is being availed of to gather most important data for the engineering world. The collecting of this data is directly looked out for by the chief of the machinery department, Mr. Thomas M. Moore, and the chief engineer of the exhibits power plant, Mr. Richard H. Pierce, assisted by a competent staff of engineers. The data, as secured, will be availed of by the jury of awards. The Krupp-made Huber press will be operated throughout the day. This press is made of built-up crucible steel gun hoops, and in normal service stands a pressure of 90,000 pounds per square inch, or double the pressure developed by a twelve-inch fifty-ton seacoast gun in throwing a 1,050-pound shell a distance of fifteen miles.

## *ELECTRICAL SECURITIES.*

The activity in the stock market during the past week compared rather unfavorably with the bulk of speculation for the week previous. At the same time, an undertone of considerable firmness was evident, and a final net advance was made. The outside public continues to hold aloof from the market, and this is becoming an important factor in the development of business. As evidence that recent reports of crop damage had been exaggerated, a considerable drop in the prices of cereals took place. The labor situation remains unchanged, with the probability that considerable trouble will be experienced by the street railway men in New York city during the next month.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 27.

| *New York:* | *Closing.* |
|---|---|
| Brooklyn Rapid Transit | 53⅞ |
| Consolidated Gas | 195¾ |
| General Electric | 164 |
| Kings County Electric | 210 |
| Manhattan Elevated | 154¼ |
| Metropolitan Elevated | 122½ |
| New York & New Jersey Telephone | 153½ |
| Westinghouse Manufacturing Company | 180 |

The stockholders of the Kings County Electric Light and Power Company as of record on September 6 are offered the right to subscribe at par until September 16 for $1,250,000 new stock, pro rata. Payment for stock subscribed for is to be made as follows: 50 per cent on or before October 1, 1904, and the balance on or before January 3, 1905.

| *Boston:* | *Closing.* |
|---|---|
| American Telephone and Telegraph | 138 |
| Edison Electric Illuminating | 260 |
| Massachusetts Electric | 61 |
| New England Telephone | 123¾ |
| Western Telephone and Telegraph preferred | 90¾ |

The American Telephone and Telegraph Company's instrument statement for the month ended July 31, 1904, is as follows: gross output, 80,348; returned, 42,842, leaving net of 37,500, as compared with 25,078 for the same month of 1903. Since December 31, 1903, the gross output has been 672,032, and the returned, 290,032, leaving a net output of 382,000, against 390,001 for the same period of the preceding year. The total now outstanding is 4,161,517. This compares with 3,540,321 for 1903, and 2,914,735 for 1902.

| *Philadelphia:* | *Closing.* |
|---|---|
| Electric Company of America | 9 |
| Electric Storage Battery common | 60 |
| Electric Storage Battery preferred | 60 |
| Philadelphia Electric | 6 ⅞ |
| Union Traction | 55⅛ |
| United Gas Improvement | 89¼ |

| *Chicago:* | *Closing.* |
|---|---|
| Chicago Telephone | 120 |
| Chicago Edison Light | 145 |
| Metropolitan Elevated preferred | 53½ |
| National Carbon common | 39 |
| National Carbon preferred | 112 |
| Union Traction common | 6⅞ |
| Union Traction preferred | 30 |

Directors of South Side Elevated have declared the regular quarterly dividend of 1 per cent, payable September 30. Books close September 19 and reopen October 1.

## INDUSTRIAL ITEMS.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has recently opened a new branch office at 411 Cortlandt street, Baltimore, Md.

THE POPE MANUFACTURING COMPANY, Hartford, Ct., has issued a booklet containing descriptions and testimonials regarding motor bicycles.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York, publishes in very neat typographical form a little booklet with descriptions and prices of "Paragon" direct-current fan motors.

H. M. BYLLESBY & COMPANY, Chicago, Ill., have recently contracted to construct and erect an extensive high-pressure gas system for the Muskogee Electric and Gas Company, Muskogee, Indian Territory.

"THE BROOKLYN EDISON" for August is devoted entirely to the illumination and power plants at Coney Island. As a sample of successful night photography and engravings this issue stands very near the top.

THE GEORGE F. BLAKE MANUFACTURING COMPANY, New York city, furnished the Great Northern Steamship Company's new steamship the Minnesota with a complete equipment of Blake marine pumps.

THE NEW YORK EDISON COMPANY, New York city, in its little magazine for August publishes a number of articles of interest to those in the electrical field, included in which is a sketch of the life of Benjamin Franklin.

THE ECK DYNAMO AND MOTOR WORKS, Belleville, N. J., in bulletins Nos. 34 and 35 describes Eck motors and dynamos for direct current. These machines are of the protected type, with exposed commutator and brush-holder.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has reprinted in booklet form from the *Western Electrician* the article "Street Lighting by Nernst Lamps in Berwin, Ill." The Nernst lamp for street work promises to be very satisfactory.

THE ALCOLM COMPANY, New York city, is publishing a New York business telephone directory, with the announced authority of the New York Telephone Company. To a great many business men this will probably prove a valuable addition to the office stationery.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, has introduced an innovation in the field of incandescent lamp advertising. The familiar story of Aladdin and the wonderful lamp will be used in exploiting the points of the Buckeye lamps. The story is well written and the typographical work very good.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., has issued a little booklet describing its exhibit at the World's Fair, St. Louis. This company is exhibiting there a large line of dynamos and motors adapted to different purposes, its exhibit of electrically driven machine tools being particularly interesting.

THE KNICKERBOCKER CONSTRUCTION COMPANY, of 15 Cortlandt street, New York, has been awarded the contract for the installation of 5,000 feet of underground cable for the Buffalo, N. Y., fire department. The cable is being manufactured by the American Electrical Works, of Phillipsdale, R. I., and 26 Cortlandt street, New York.

THE ABNER DOBLE COMPANY, San Francisco, Cal., has recently issued a catalogue descriptive of its tangential water-wheels. These wheels have been developed to meet the demand for water-wheels operating under high heads. The California Gas and Electric Corporation and the Edison Electric Company of Los Angeles are among the users of the Doble wheels.

R. D. WOOD & COMPANY, Philadelphia, Pa., manufacturers of producer gas apparatus, have issued a St. Louis edition of their catalogue. The subtitle "One Horse-Power, One Hour, One Pound of Coal" will be attractive to users of power. Installations of the Wood company are designed to generate directly from fuel a combustible gas which passes to the engine cylinder after cleaning and cooling. In addition to the gas plants, this company manufacture cast-iron pipe and special castings as well as pumping and hydraulic machinery and gas-holders.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued the following publications, fliers No. 2134, ready made electric lighting outfits for decorative lighting; No. 2138, enclosed fuse cutouts; No. 2139, C. A. generators; No. 2140, direct-current ceiling fan motors; and bulletins No. 4381, small plant alternating-current switchboards; and No. 4382, Thomson inclined coil portable indicating instruments.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., believing that central power stations can greatly increase their output by interesting small users of current, has devised a line of motors for this purpose. Among these specialties are the "Orgoblo" for blowing church organs; house pumping outfits; motors for ice cream freezers, grocers' coffee mills and bakers' dough mixers.

THE ALBERGER CONDENSER COMPANY, New York city, publishes a booklet in which are illustrated the various types of condensers, vacuum and circulating pumps recently manufactured by the company in connection with steam turbines and reciprocating engines for high vacuums. Among the large installations which this company has made is included the new power-house of the New York subway.

THE MILLER ANCHOR COMPANY, Norwalk, Ohio, reports receiving a number of enquiries from foreign countries, including Mexico, Spain, Greece and Japan. Negotiations are under way for the sale of the Japan patent. A test was recently made by the Japanese government at Osaka, Japan, and was attended with the best of results. Flattering comments were made on the principle of the anchor and its holding power.

THE ALLIS-CHALMERS COMPANY, Chicago, under the caption "The Book of the Four Powers" has published a catalogue setting forth the scope of its manufacturers. The four powers are steam, gas, water and electricity. In the book are described types of machines devoted to these four powers and installed in every part of the globe. The typographical work and illustrations are excellent, while the illuminated double covers may be classed as works of art.

THE C & C ELECTRIC COMPANY, New York, in bulletin No. 151 sets forth the advantages of the type "S" direct-current dynamos and motors. These machines are suitable for all classes of lighting and power service and may be used belted or direct-connected to turbines, steam, gas, or oil engines. The motors can be furnished in floor, wall and ceiling horizontal types or in the vertical type with shunt projecting either upward or downward. The confidence of the maker is shown by an iron-clad guarantee.

THE SPRAGUE ELECTRIC COMPANY, New York city, reports an excellent business in the electric hoist department. Among recent orders are eight electric hoists for Davis & Thomas Company, Catasauqua, Pa., to be used in handling castings for the new Pennsylvania Railway tunnel under New York city; thirteen hoists for the Pennsylvania Railway Company car wheel foundry at Altoona, Pa., and twenty hoists for the new works of the International Steam Pump Company, at Harrison, N. J.

THE POWER SPECIALTY COMPANY, 126 Liberty street, New York, has published data of comparative tests with saturated and superheated steam made at Brooklyn and Chicago waterworks. These tests prove conclusively the value of superheated steam. A catalogue published by the company sets forth further the value of superheated steam and shows cuts of apparatus used. The following firms have closed contracts with the Power Specialty Company for the installation of Foster superheaters: Laclede Power Company, St. Louis, Mo.; Columbian Improvement Company, Terre Haute, Ind.; Franklin Rubber Company, Boston, Mass.; Bradley-Ramsey Lumber Company, Lake Charles, La.; A. B. Wrisley & Company, Chicago, Ill.; H. F. Watson & Company, Erie, Pa.; Samuel Horner, Jr., Riverside, Ky.; Belt Light and Power Company, Lead, S. Dak.; Milwaukee Electric Railway and Light Company, Milwaukee, Wis.; Philadelphia, Coatesville & Lancaster Railway Company, Philadelphia, Pa.